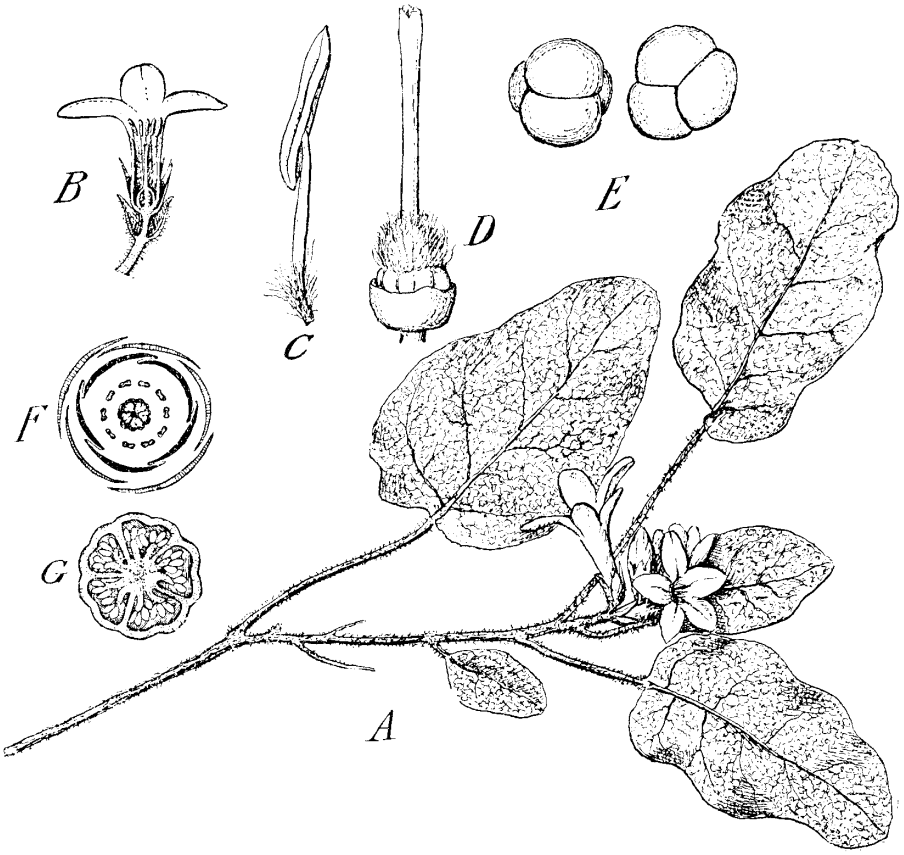
AMERICAN JOURNAL OF PHARMACY
Volume 67, #5, May, 1895

Botanical Medicine Monographs and Sundry



EPIGÆA REPENS.

STRUCTURE OF EPIGAEA REPENS.

By EDSON S. BASTIN.

The "first sweet smiles of May," as Whittier calls the flowers of this plant, prettily portray the fact that they are at once among the earliest and the most prized of our spring floral treasures.

In most localities where the plant is known it is called the Trailing Arbutus, but in Massachusetts and some other portions of New England

it is commonly called the Mayflower, partly, perhaps, in allusion to its time of blossoming, and partly to the fact that it was the first flower to gladden the eyes of the Pilgrims in the spring after their first winter on the bleak shores of their new home.

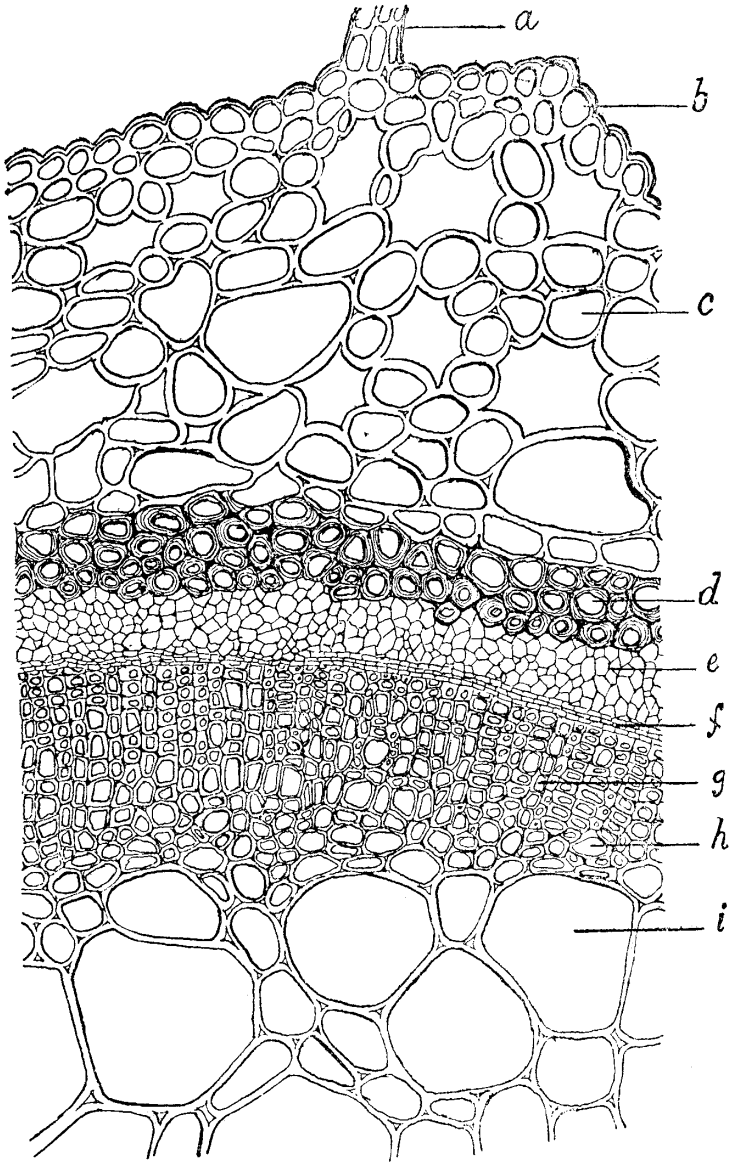


FIG. 1.

The plant is widely distributed over the northeastern part of North America, but is especially abundant in the region of the Alleghenies and in the pine and fir-clad regions bordering the Great Lakes and the St. Lawrence River. It particularly affects rocky hill slopes, where the soil is light and well drained, but is not infrequently found on lower-lying sandy, tree-clad areas, where the soil is well aerated. The sturdy little plant also prefers the vigorous north, and is seldom found south of the

line of the Ohio River, save in the more elevated portions of the Alleghenies. Its stems are prostrate, and the slender trailing branches often attain a foot in length, and possess, like the petioles and the under surfaces of the leaves, a copious growth of rusty-brown, multicellular, but simple hairs. These also occur, but much more sparingly, on the upper surface of the leaves. The leaves are evergreen, veiny, scarcely coriaceous, deep green above, from 3 to 6 cm. long, elliptic in outline, ciliate-margined, cordate, or sometimes rounded at the base, cuspidate at the apex, exstipulate, but provided with petioles which are nearly as long as the leaf blades.

The fragrant flowers are arranged in short, almost spike-like racemes at the ends of the stems, and when they unfold in the spring are often quite concealed from view by dead leaves which have fallen from the overhanging trees. The flowers are white or rose-tinged, and attain a length of 1 1/2 or 2 cm. The pedicels are only two or three mm. long, and covered with rusty-brown hairs, as are also the scaly bracts which subtend the flowers. The calyx is deeply five-parted and the segments are erect, lanceolate, entire, nearly smooth, about the length of the corolla tube, pointed and scale-like. The corolla is hypogynous, salver-shaped, and the lobes of its five-parted limb are ovate, entire, obtuse or mucronate, and alternate with the segments of the calyx. The tube is hairy on its interior. The androecium consists of ten stamens, as in most other Ericaceae, and they appear to be in but one whorl, though probably this is the result of a condensation from two.

The flowers, according to the investigations of Prof. W.P.Wilson, are really dioecious, though most of them still possess both stamens and pistils. In the pistillate flowers, which are rose.colored, the stamens have sometimes completely disappeared, though in most instances they are still present, but functionless and smaller than they are in the staminate white flowers. The staminate flowers differ from each other also, some having long stamens, others short ones, and still others those of intermediate length. There is a corresponding difference also in the length of the styles. The history of the flower, then, according to Prof. Wilson, is as follows: It was at first hermaphrodite, and the flowers of the species all had the same form. It then became dimorphous, later on trimorphous, and finally the stamens in some flowers and the pistils in others became abortive, as is the case with the species at the present time. It may therefore be safely predicted that in the process of evolution still going on the last vestige of stamens from the pistillate flowers, and

of pistils from the staminate ones, will ultimately disappear.

The insertion of the stamens is, as in most other Ericacese, on the receptacle, and not on the tube of the corolla, differing thus from most other gamopetalae, in which they are adnate to the tube of the corolla. The filaments are bearded at the base and alternate toward the apex. The anthers are introrse, versatile, 2-celled, and differ from those of the majority of the family in the fact that they dehisce longitudinally rather than by means of apical pores.

The pollen grains also differ from those of most other plants outside this natural order in the fact that each is composed of a group of four cells.

The pistil is 5-carpeled, the ovary faintly 10-lobed exteriorly, 5-celled interiorly, with an axile placentation and very numerous ovules. The style is erect, unbranching and crowned, in the pistillate flower, with a star-shaped, 5-rayed stigma. The stigmas of the staminate flowers are also 5-lobed, but the lobes never open.

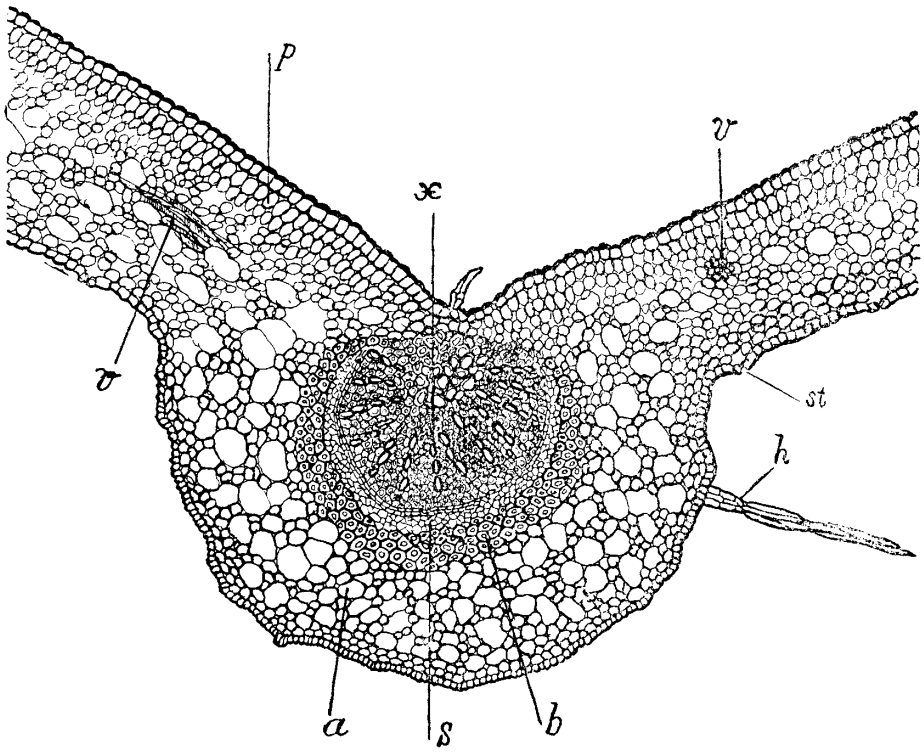


FIG. 2.

A study of the cross-section of the stem shows such a structure as that drawn in Fig. 2; a small-celled epidermis, a loosely-arranged cortical parenchyma, whose cells vary greatly in size, a zone of well-developed bast-fibres in the outer phloem, a narrow zone of wood with a rather large pith composed of parenchyma cells, some of which are small or moderate in size, others relatively very large.

A cross-section of a leaf near its base shows the vascular area constituting the midrib to possess an outer crescent-shaped mass of bast-fibres, the horns of which are presented toward the upper surface of the leaf. Lining this is a thinner crescent of soft bast, which in turn includes a short, thick crescentic mass of xylem tissues. The latter shows a distinct radial arrangement of its elements, and these rays focus upon a small area of parenchymatous tissues included between the horns of the inner crescent. This parenchyma, the xylem tissues, and the bast-fibres, in the mature leaf, are all strongly lignified. Exterior to the crescent-shaped area of bast-fibres is a region of loosely-arranged parenchyma enclosing the bundle, except on its upper side, and extending nearly to the epidermis below, and laterally to form the spongy parenchyma of the thin portions of the lamina. This parenchyma is quite similar in appearance to that composing the pith of the stem.

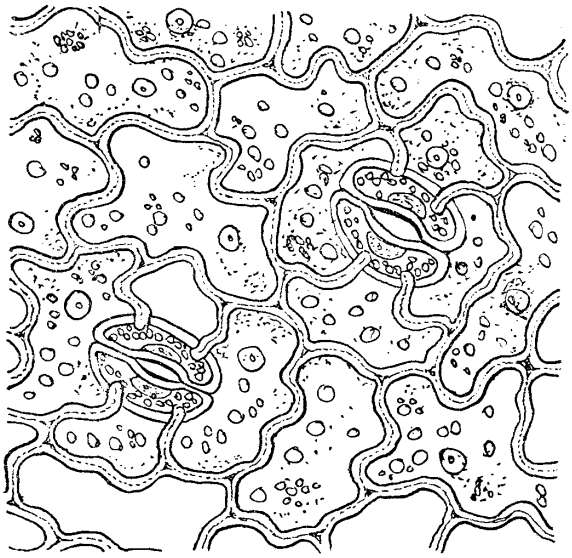


FIG. 3.

The epidermis is one-layered and rather small-celled, and the cells of the lower are smaller than those of the upper epidermis. The cuticle is

thinner than that of most evergreen leaves. The rather compactly-arranged chlorophyll-bearing cells which face the upper epidermis differ from most palisade tissue in being but slightly lengthened. There are two or three layers of these cells.

The ordinary epidermal cells, in surface view, appear strongly wavy in outline, or lobed, and there is little difference of shape between those of the upper and those of the lower face of the leaf. Stomata occur also on both surfaces, but are more abundant on the lower.

DESCRIPTION OF FIGURES.

Frontispiece.—Trailing Arbutus.

A.—Flowering shoot about three-fourths natural size.
B.—Vertical section.of a flower.
C.—Stamen, much enlarged.
D.—A pistil, also much enlarged.
E.—Pollen grains.
F.—Ground plan of flower.
G.—Enlarged view of cross-section of ovary, showing axile placentation.

[The above drawings are reproduced from the author's Laboratory Exercises in Botany.]

Fig. 1.—Portion of cross-section of stem magnified 230 diameters; *a*, base of one of the hairs; *b*, epidermal cell; *c*, cell of loosely-arranged cortical parenchyma; *d*, bast-fibres; *e*, soft bast; *f*, cambium zone; *g*, medullary ray; *h*, duct in xylem; *i*, one of the large parenchyma cells of the pith.

Fig. 2 —Portion of cross-section made near base of leaf of Epigaea. Magnification 75 diameters; *p*, palisade tissue, composed of cells scarcely elongated; *h*, a hair; *st*, a stoma; *v*, section of a veinlet; *b*, bast-fibres; *s*, soft bast; *x*, duct in xylem; *a*, spongy parenchymatous tissue composed of large and small cells.

Fig. 3.—Small portion of lower epidermis of leaf magnified 560 diameters, showing ordinary epidermal cells and stomata.

NOTES ON SOME SAPS AND SECRETIONS USED IN PHARMACY.

BY P. L. SIMMONDS, F.L.S.

[Continued from March.]

Garcinia, sp. The yellow gum resin known as gamboge and used as a pigment and in medicine is believed to be obtained from different species of this family. From *G. cochin chinensis,* Chois., *G. Morella*, Desv., *G. pictoria,* Roxb., *G. Hanburii,* Hook. fil. Several Indian species of *Garcinia* seem to furnish gamboge.

It is chiefly received from Siam in the form of pipe or roll, and in cylindrical masses. It has a faint odor, and an acrid, rancid, afterwards sweetish taste. It is employed medicinally in the treatment of dropsical affections, amenorrhoea and obstinate constipation, attended with torpidity of the bowels, and has frequently been found effectual in the expulsion of the tape-worm. It is a valuable drastic and hydragogue cathartic, and also possesses anthelmintic and diuretic properties. It consists of 75 per cent. of resin and 15 of gum.

On the Continent of Europe it is known as "gum gutte," from the mode of its preparation. When the sap of the tree is in active circulation, the leaves and young branches are broken off, and the yellow juice that flows from the wounds is collected in cocoanut shells, or twisted leaves, of the plant itself. This is afterwards poured into larger vessels, made of clay, and dried in the sun until it is of a proper consistence.

G. bowa, Roxb., yields a kind of gamboge of a somewhat paler color than that produced by *G. Morella,*

Gardenia lucida, Roxb. A fragrant exudation, known in India as " Dikamale resin," is procured from the tops of the branches. It is extensively used in Indian hospitals as a slight dressing for open wounds, to keep away flies from the sores, on account of its strong aroma.

Guaiacum officinale, Lin. A medicinal resin is obtained from the stem of this tree, called lignum vitae. It exudes spontaneously, and is partly obtained by extracting with alcohol. The resin is obtained most copiously by wounding the tree, which is usually done in May. Another method is

by heat. The trunk and larger limbs being sawn into billets of about three feet in length, an angular hole is bored lengthwise in each, and one end of the billets so placed on a fire that a calabash may receive the melted resin, which runs through the hole as the wood burns. It is also obtained in small quantities by boiling chips or shavings of wood in water, with common salt. The resin swims on the top and may be skimmed off.

The resin is inside reddish or greenish-brown, brittle, gray-white when pulverized, turns greenish in the air, has a balsamic odor and a sweetish bitter taste, which is at the same time acrid and irritating to the throat. The resin is chiefly used in gout, chronic rheumatism, etc. A decoction of the capsules, wood or bark is also used in medicine as a sudorific. A tincture made of the resin diluted with water is used to cleanse the mouth, strengthen the gums and relieve the toothache.

The British imports are small, seldom exceeding thirty or forty packages in a year. The guaiacum in tears is supposed to be the product of *G. sanctum*, Lin.

Humirium floribundum, Mart. This plant, in Brazil, yields from its trunk, when wounded, a fragrant, limpid, pale-yellow balsam, called Umiri, possessing the same medicinal qualities as Balsam of Copaiva. It is used by the natives for gonorrhoea, chronic cystitis, bronchitis, and all diseases attended with excessive secretion. A decoction of the bark is used as a remedy for coughs and derangement of the stomach. Another species, H. balsawitferum, Aubl., yields a similar balsam in Guiana.

Hymenaea Courbasil, Lin. A fine, transparent, fragant gum-resin exudes from this tree. In solution it has been given internally in doses of a teaspoonful for rheumatic and pseudo-syphilitic complaints, and employed externally as an embrocation. In Brazil the resin is mixed with sugar and rum, so as to make an agreeable emulsion or syrup, which is administered in tedious coughs, weakness of the lungs, spitting of blood and incipient phthisis pulmonalis. A decoction of the inner bark is said to act as a vermifuge.

Icica Tacamahaca, Kth. The fragrant, bitter resin of the above species is used in Brazil for making ointments. Another Tacamahaca from *Elaphrium tomentosa*, Jacqu., fetches in Mexico $1 a pound. The resin of *Icica heptaphylla*, Aubl., in Venezuela, takes the properties of Thus.

When liquid it is a valuable remedy for coughs. A decoction of the bark is an emetic in fevers The *Calophyllum Calaba*, Lin., yields East Indian Tacamahaca.

Icica icicariba, DeC., produces a great deal of the resin passing under the name of "Almaciga," which is much used in medicine and the arts. It is found in the provinces of Maranham, Para and Amazon, in Brazil. Another Icica, known as "Pave de brea," also furnishes it in the same provinces. Some of the resin known as Almaciga is said to be furnished by *Bursera balsamifera*, Pers., *Hedwigia balsamifera*, Sw., and is aromatic like incense. Elemi proper is from *I. icicariba*, DeC., and *I. araconchini*, Aubl., but is often replaced by the resin of other species of the same genus. The odorous resin which exudes from the trunk, gives off, in burning, a lively, agreeable odor. This is used as incense in the churches of French Guiana. It is sometimes used medicinally as balsam of Araconchi, but there is little demand for it in commerce. On wounding the bark of the Jamaica birch (*Bursera gummifera*, Jacq.), a white, resinous sap exudes, which soon hardens and is in no way different from gum Elemi.

Elaphrium Jacquinianum and *E. elemiferum*, natives of Mexico, also produce a fragrant balsamic, glutinous resin, which furnishes one of the sorts of Elemi. Elemi is very friable, and, when heated, puffs up and melts. In boiling water it agglomerates without melting; slightly soluble in ether, insoluble in acetic acid and caustic soda, slightly soluble in carbonic sulphide, soluble in turpentine, slightly soluble in boiling linseed oil, benzine and oil of naphtha. Sulphuric acid dissolves it, coloring it a dark bistre; nitric acid colors it a dirty yellow without dissolving it, and ammonia does not act upon it. What is known as Manila elemi is believed to be a resinous exudation from *Canarium commune*, Lin. In burning, elemi gives out a lively and agreeable odor, hence it is used for incense in some churches.

KINO. Under this common name is known as an astringent and resinous deposit, being the dried sap of several trees of India, Africa and Australia.

The best Kino, which contains about 75 per cent. of tannic acid, exudes from the sap of *Pterocarpus marsupium*, DeC., in India, and dries in angular pea-like grains in the course of a day or two. Another kind which was originally brought from Africa, under the native name of

Kano, is the sap of *Pterocarpus erinaceus*, Poir.

Nearly all the Australian Eucalypti exude astringent gum resins in considerable quantity, resembling Kino in appearance and property.

The red juice which flows from fissures in the barks of the Indian creepers, *Butea superba* and *B. frondosa*, Roxb., yields some of the Indian Kinos. Kino is commonly used in medicine as a powerful astringent, especially in diarrhoea, chronic dysentery and other such cases, and as an injection in leucorrhcea, and as an application to ulcers.

The tincture of Kino, although used medicinally, has an inconvenience, which is found to arise from its changing to the gelatinous form.

Kino resin is dearer than it has ever been within living memory, £20 per cwt. being now the nominal quotation.

The British imports are very small, only averaging 15 or 16 packages now, whereas they were 98 in 1884, and 73 in 1888.

Lactuca species. From several species of Lettuca—*L. virosa*, *L. scariola*, *L. altissima* and *L. sativa*—the drug known as "Lactucarium" is obtained. It is the hardened, milky juice which exudes from the cut stems in Germany, France and Austria. The average yield from each plant is only from 40 to 50 grains. It occurs in commerce in the form of angular pieces of a brownish color, internally opaque and wax-like. It possesses slightly narcotic properties and is useful in coughs.

Laurus gigantea.—"Caparrapi balsam" is referred to this tree. It is so named from the village of Caparrapi, in the province of Cudinamarca, Colombia, where it is prepared. It may probably be derived from *Oreodaphne epifera*, Nees. The seed is oily and has a burning taste like capsicum. The balsam has an aromatic odor and resembles balsam of Tolu, but is more fluid.

In medicine it is used by the natives as a stimulant in catarrhal complaints, and is also employed by them in the treatment of snake bites and the stings of poisonous insects.

Liquidambar orientale. Miller; *L. imberbe*, Aiton. A balsamic gum-resin, prepared from the bark, is known as liquid Storax, and in the East as

"Rose Malloes." It is stimulant and detergent and similar in action to the balsams of Peru and Tolu.

Another species, *L. styraciflua*, Lin., exudes a sweet gum through cracks in the bark and wounds in the trunk, during all seasons of the year, which hardens on exposure to the air. It is much esteemed by children for chewing and is soluble in water. This gum yields a balsam more terebinthine in odor, but almost as pleasant as Tolu balsam. This syrup is produced in the Southern States of America. It is transparent, amber-yellow, has the consistence of a thick oil, and an aromatic, bitter taste. It has been used in the form of ointment for healing indolent ulcers, and for cutaneous diseases.

A syrup of Liquidambar is used for the diarrhoea of infants. It is largely exported from Bombay to China, where it has for many centuries been used as a medicine. The dried and compressed residual bark, after boiling for the storax, constitutes the fragrant cakes formerly common and well known in Europe, under the name of *Cortex Thymiamatis*.

L. altingia, Blume, also yields the fragrant balsam known as liquid storax. It is vanilla-scented, containing much styrol and styracin, and is often used for imparting scent to some sorts of tobacco and cigars, and also for keeping moths from clothing. Its use in medicine is more limited than in perfumery. The solid exudation known as storax is from the stem of *Styrax officinale*.

Moringa pterygosperma, Gaertn. This small tree yields a gum which is white as it exudes, but gradually turns to a mahogany or claret color as it dries. This is one of the balsa Tragacanths which are used in native medicine.

Musa paradisiaca, Lin. The sap has medicinal properties; it is used in San Domingo to stop internal and external hemorrhage, as tannin is in other countries. At the Philippines it is used to heal a species of venereal disease, very common in the province of Biscayas,

[To be continued.]

SWEET CASSAVA.

BY HARVEY W. WILEY.
(Abstracted from Bulletin No. 44, U. S. Department of Agriculture, Division of Chemistry.)

In the southern peninsula of Florida, and growing well up into the frost belt, is found in many localities a cultivated plant known as cassava, or sweet cassava. From a careful study of the climatic conditions under which the plant flourishes, it is safe to assume that it may also be grown with success in southern Alabama, Mississippi, Louisiana and Texas. Cassava is a name which should properly apply only to the purified starch derived from the roots of the plant, but it has passed into general use to designate the plant itself. Botanically, the plant is known as *Janipha manihot*, *Manihot utilissima*, *Jatropha manihot*, *Manihot aipi*, *Manihot loeflingii*, and *Manihot palmata*. One of its common names is manioc plant.

There is properly only one variety of the plant growing in Florida, while that variety which grows in the tropics contains so much hydrocyanic acid as to render it poisonous. The variety grown in the subtropical region of Florida, however, contains only a small quantity of hydrocyanic acid, and is, therefore, commonly known as sweet cassava. It is quite probable that after the tropical variety has grown for some time in a subtropical climate, it would lose largely its poisonous properties.

The attention of the Division of Chemistry was first called to the cassava plant as an article of food and a possible source of starch, in 1888, in a letter received from Mr. R. H. Burr, of Bartow, Fla., who also sent a package of the roots. These roots were long, slender and of various sizes, some of them two feet long and weighing several pounds. The analysis of the substance, exclusive of the bark, calculated to dry substance, is given in the following table:

	Per Cent.
Ash	1·94
Oil (petroleum ether extract)	1·27
Ether extract (resins, etc.)	0·74
Alcohol extract (amides, sugars, glucosides, etc.)	17·43
Crude fibre	4·03
Starch	71·85
Albuminoids (calculated from nitrogen)	3·47
	100·73

The amount of starch compares fairly well with the best varieties of potatoes. On account of the large quantities of sugars present, the cassava root could be more economically used fer the manufacture of glucose than for starch.

A larger quantity of the root was obtained from Florida, the bark separated from the root, and each subjected to analysis, with the following results :

	Peeled Root.		Fibre after removal of Starch.	Bark of Root.	
	Fresh.	Dry.	Dry.	Fresh.	Dry.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Moisture	61·30	—	—	61·30	—
Ether extract	·17	·44	·30	·66	1·70
Albuminoids (N × 6·35)	·64	1·66	1·02	2·29	5·91
Starch	30·98	80·06	64·64	—	—
Fibre	·88	2·26	10·68	3 83	9·89
Ash	·51	1·31	1·42	2·02	5·23
Undetermined	5·52	14·27	21·94	29 90	77 27
	100·00	100·00	100·00	100·00	100·00

With the starch in the analysis given above is reckoned also the soluble carbohydrates, consisting almost exclusively of cane sugar, and of which, in an analysis of another portion of the dry substance, as high as 17 per cent. was found. In the laboratory it is not difficult to prepare crystallized cane sugar from the aqueous extract of the fresh pulp. The percentage of sugar in the plant, however, is too low to excite any reasonable hope of the preparation of this article on a commercial scale. The most promising way to save it is by conversion into glucose, as indicated in another place. The undetermined portion consists of the digestible fibre and carbohydrates of the pentose series. The pentosans in the fibre were determined by the furfurol process, as modified by Krug, and the amount in the air-dried material was found to be 3.92 per cent., and in the material after the removal of the starch, 5.33 per cent.

The amount of mineral matter taken from the soil by the 100 kilos of the fresh root is approximately only one-half a kilo. The albuminous matters

are also present in small quantities, being only slightly more in amount than the ash itself. The plant, therefore, is one which seems particularly suited to feed almost exclusively from the air and water, and hence is one which could be recommended on the sandy soils of Florida as a crop which would require the minimum of fertilization.

The ash was found to consist of silica, ferric oxide, calcium oxide, magnesium oxide, sodium oxide, potassium oxide, phosphoric acid, sulphuric acid, carbonic acid, and chlorine. The calcium, potassium and phosphoric acid made up three-fourths of the ash in the peeled root, while silica and potassium predominated in the bark from the root.

Quite a number of preparations are made from the starch of the root, and among them may be mentioned: (1) Tapioca; the first portions of starch washed out, especially, produce an excellent article of tapioca when treated in the usual way. (2) Glucose; both the fresh root and the extracted root yield full theoretical amounts of glucose, and samples of this article were made by the conversion of the starch both by sulphuric acid and by diastase. The samples of glucose made from the starch were exceptionally good, especially when diastase was used, the glucose in this case containing large quantities of maltase. (3) Alcohol; the glucose on fermentation affords the usual quantity of alcohol. (4) Cane sugar; a beautiful preparation of cane sugar was made from the water used in washing out the starch. The amount of cane sugar, however, is not large enough to warrant its extraction on a commercial scale from the waters used in washing. It is, however, present in such quantity as to indicate that in making glucose it is better to use the whole root, and so obtain the product from both the cane sugar and the starch, rather than to make it from the starch alone.

The general result of the investigation is to establish the fact that the cassava is .a plant of high economic value, and worthy of the attention of those interested in the carbohydrate products of the country.

Cassava has been grown for one year on the department experiment station at Runnymede (post-office, Narcoossee), Osceola County, Florida. The field in which the crop was grown is high pine sand, with almost no other ingredient.

Attempts were also made to grow cassava in a piece of very wet muck land on the station, in which sugar cane would not grow to any

advantage. An immense development of tips was secured, some of the plants reaching a height of 10 feet, and resembling young trees. The root development was fair, but not commensurately increased with the top growth.

The profits which the farmer may make from growing this crop, and the manufacturer from using it, should be based upon a yield of 4 or 5 tons per acre. If it be desired to make starch from the plant, we may suppose, as a minimum rate of yield, that 20 per cent. of the weight of the fresh root may be obtained as a merchantable starch of a high grade. On a yield of 4 tons per acre, this would amount to 1,600 pounds. Compare this with the weight of starch obtained from Indian corn producing 40 bushels per-acre, The yield of merchantable starch of a high grade maybe placed 35 pounds per bushel, which for 40 bushels would amount to 1,400 pounds. It is thus seen that the yield per acre in the matter of starch from cassava would be fully equal, if not superior, to that from Indian corn. If the manufacture of glucose be considered, the estimate is even more favorable.

CONCLUSIONS.

(1) Cassava can be cultivated with safety and profit in the greater part of the peninsula of Florida, and probably also in southern Alabama, Mississippi, Louisiana and Texas.

(2) It will yield, with fair treatment, on sand soils, from 4 to 5 tons per acre.

(3) It will give, when properly manufactured, from 20 to 25 per cent. of the weight of the fresh root in starch of high grade.

(4) The starch is naturally in a pure state, and no chemicals of any kind are necessary in its manufacture.

(5) The starch resembles, in its physical properties, that of maize, and can be used as a substitute therefor in all cases.

(6) An excellent article of tapioca can be prepared from the starch of the cassava plant.

(7) Glucose can be prepared directly from the starch, or more profitably

from the pulp of the peeled root.

(8) The plant furnishes an excellent human and cattle food, deficient, however, in nitrogen. It would make a well-balanced ration for cattle when mixed with one-fourth its weight of cotton-seed oilcake.