291 Method of culture, &c. for which a premium was granted.

Account of the culture, expences, and produce of ſix acres of potatoes, being a fair part of near ſeventy acres, raiſed by John Billingſley, Eſq. and for which the premium was granted him in the year 1784.

Expences.

Ploughing an out-ſtubble in October 1783, at 4s. *per* acre	L. 1	4	0
Croſs-ploughing in March 1784	1	4	0
Harrowing, 2s. *per* acre	0	12	0
180 cart-loads of compoſt, 3l. *per* acre	18	0	0
42 ſacks of ſeed-potatoes (each ſack weighing 240lb.) of the white ſort	10	10	0
Cutting the ſets, 6d *per* ſack	1	1	0
Setting on ridges eight feet wide (leaving an interval of two feet for an alley) 6d for every 20 yards	10	12	0
Hoeing, at 5s. *per* acre	1	10	0
Digging up the two feet interval, and throwing the earth on the plants, at 10s. *per* acre	3	0	0
Digging up the crop at 8d. for every 20 yards in length, the breadth being 8 feet	14	6	0
Labour and expence of ſecuring in pits, wear and tear of baſkets, ſtraw, reed, ſpikes, &c. 10s. *per* acre	3	0	0
Rent	6	0	0
Tithe	1	10	0
	72	9	0
Profit	73	11	0
	L. 146	0	0

Produce.

600 ſacks of beſt potatoes at 4s.	L. 120	0	0
120 ſacks middle-ſized, 3s. 6d.	11	0	0
50 of ſmall, 2s.	5	0	0
N. B. Each ſack 240lb.			
	L. 146	0	0

The field on which the above experiment was made, was an out-ſtubble in the autumn of 1783. In October it was ploughed, and left in a rough ſtate during the winter. In April it was croſs-ploughed and harrowed. On the 8th of May the field was marked out into beds or ridges eight feet wide, leaving a ſpace of two feet wide for an alley between every two ridges. The manure (a compoſt of ſtable dung, virgin earth, and ſcrapings of a turnpike road) was then brought on the land, and depoſited in ſmall heaps on the centre of each ridge, in the proportion of about thirty cart-loads to each acre. A trench was then opened with a ſpade, breadth-way of the ridge, about four inches deep; in this trench the potato ſets were placed, at the diſtance of nine inches from each other; the dung was then ſpread in a trench on the ſets, and a ſpace or ſplit of 14 inches in breadth dug in upon them. When the plants were about ſix inches high, they were carefully hoed, and ſoon after the two feet intervals between the ridges were dug, and the contents thrown around the young plants. This refreſhment, added to the ample manuring previouſly beſtowed, produced ſuch a luxuriance and rapidity of growth, that no weed could ſhow its head.

292 Beſt method of taking them up.

The ſhorteſt and moſt certain method of taking up potatoes, is to plough once round every row at the diſtance of four inches, removing the earth from the plants, and gathering up with the hand all the potatoes that appear. The diſtance is made four inches, to prevent cutting the roots, which are ſeldom found above that diſtance from the row on each ſide. When the ground is thus cleared by the plough, raiſe the potatoes with a fork having three broad toes or claws; which is better than a ſpade, as it does not cut the potatoes. The potatoes thus laid above ground muſt be gathered with the hand. By this method ſcarce a potato will be left.

293 Of preſerving them.

As potatoes are a comfortable food for the common people, it is of importance to have them all the year round. For a long time, potatoes in Scotland were confined to the kitchen garden; and after they were planted in the field, it was not imagined at firſt that they could be uſed after the month of December. Of late years, they have been found to anſwer even till midſummer; which has proved a great ſupport to many a poor family, as they are eaſily cooked, and require neither kiln nor mill. But there is no cauſe for ſtopping there. It is eaſy to preſerve them till the next crop: When taken out of the ground, lay in the corner of a barn a quantity that may ſerve till April, covered from froſt with dry ſtraw preſſed down: bury the remainder in a hole dug in dry ground, mixed with the huſks of dried oats, ſand, or the dry leaves of trees, over which build a ſtack of hay or corn. When the pit is opened for taking out the potatoes, the eyes of what have a tendency to puſh muſt be cut out; and this cargo will ſerve all the month of June. To be ſtill more certain of making the old crop meet the new, the ſetting of a ſmall quantity may be delayed till June, to be taken up at the ordinary time before froſt. This cargo, having not arrived to full growth, will not be ſo ready to puſh as what are ſet in April.

If the old crop happen to be exhauſted before the new crop is ready, the interval may be ſupplied by the potatoes of the new crop that lie next the ſurface, to be picked up with the hand; which, far from hurting the crop, will rather improve it.

294 Mr Young's experiments on the cluſtered potato.

In the Tranſactions of the Society for the encouragement of Arts, a number of experiments are related by Mr Young on that kind called the *cluſtered* or *hog potato*, which he ſtrongly recommends as food for the poor, in preference to the kidney or other more expenſive kinds. The following is the reſult of the moſt remarkable of his experiments.

In the firſt week of March 1780, two acres and a quarter of barley ſtubble were ſown with the cluſter potato, which appeared on the 23d of May. A ſharp froſt on the 7th of June turned them as black as they uſually are by the froſts of November and December. In time, however, they recovered; and by the end of October produced 876 buſhels from the $2\frac{1}{4}$ acres; which, when cleaned, were reduced to 780, or 350 buſhels *per* acre; thus affording, when valued only at 6d. *per* buſhel, a clear profit of 7l. 14s. 4d. *per* acre. The experiment, however, in his opinion, would have been ſtill more profitable, had it not been for the following circumſtances: 1. The ſoil was not altogether proper. 2. The crop was grievouſly injured by the froſt already mentioned, which, in our author's opinion, retarded the growth for about ſix weeks. 3. The dung was not of his own raiſing, but purchaſed; which cannot but be ſuppoſed to make a great difference, not only on account of the price, but likewiſe of the qua-

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lity, as happened to be the caſe at preſent. He is of opinion, however, that potatoes, at leaſt this kind of them, are an exhauſting crop. Having ſown the field after this large crop of potatoes with wheat, his neighbours were of opinion that it would be too rank; but ſo far was this from being the caſe, that the wheat ſhowed not the leaſt ſign of luxuriance, nor the leaſt ſuperiority over the parts adjacent which were ſown without dung. He was willing to account for this by the poverty of the dung, and the ſevere cropping which the ground had undergone while in the poſſeſſion of the former tenant. In another experiment, however, in which the ground had been likewiſe exhauſted by ſevere cropping, the ſucceeding crop of wheat ſhowed no luxuriance; ſo that the former ſuſpicion of the exhauſting quality of the cluſter potato was rather confirmed. The ground was a fine turnip loam; but though the produce was even greater than in the former caſe, viz. 356 buſhels from an acre, the profit was much leſs, viz. only 4l. 15s. 6d. An acre of ley ground was ſown at the ſame time with the turnip loam, but the produce from it was only 200 buſhels. Mr Young ſuppoſes that the produce would have been greater if the potatoes had been planted with an iron dibble, as the turf, in ploughing, lay too heavy upon the ſeed. A few rows of other potatoes, planted along with the cluſtered kind, did not vegetate at all; which ſhows that the latter have a more powerful vegetative faculty.

295 Experiments on a larger ſcale.

Having ſucceeded ſo well with his experiments on this kind of potato hitherto, Mr Young determined to try the culture of them upon a larger ſcale: and therefore, in the year 1782, ſowed 11 acres: but being obliged to commit the care of ſowing them to an ignorant labourer, his unſkilfulneſs, together with the exceſſive cold and moiſture of that ſeaſon, ſo diminiſhed the produce, that he had only a ſingle acre out of the whole. This produced 180 buſhels, which yielded of clear profit 4l. 2s. 6d. From this experiment he draws the following concluſions: 1. "That the poor loam, on which theſe potatoes were ſown, will yield a crop of cluſter-potatoes, though not of any other kind. 2. That the manure for potatoes ought to be carted and ſpread upon all ſoils inclinable to wet before the planting ſeaſon, either in autumn preceding, or elſe during a hard froſt." In 1783 he ſucceeded ſtill worſe; for having that year ſown three acres and a half, the profit did not exceed 11s. 4d. per acre. The produce was about 224 buſhels per acre. He gives two reaſons for the failure of this crop: 1. The cluſtered potato thrives beſt in wet years; but the ſummer of 1783 was dry and hot. 2. The ſpring froſt, by interrupting the hoeing, not only greatly raiſed the expences, but very much injured the crop by encouraging the growth of weeds. Barley was ſown after the laſt crop, and produced well: ſo that our author thinks the potatoes ſeem to be a better preparation for ſpring corn than wheat. His experiment in 1784 produced a clear profit of 2l. 0s. 4d.; the produce being 250 buſhels per acre. Still, however, an error was committed, by employing an old man and woman to cut the ſets, by whoſe unſkilfulneſs there were many great gaps among the potatoes as they came up; ſo that, on the whole he reckons that he thus loſt from 500 to 800 buſhels.

296 Concluſion favourable to the cultivation of this kind.

On the whole, however, his opinion is favourable to the cluſter potato. "With ſmall crops (ſays he), and at the low rate of value which is produced by conſuming them at home, they are clearly proved to be a crop which will pay the expence of manuring, and very ample tillage and hoeing. This is, after all, the chief object of modern huſbandry; for if a man can rely upon this potato for the winter conſumption for his yard in fattening or keeping hogs, in feeding his horſes, and fattening his bullocks, he has made one of the greateſt acquiſitions that can be deſired; ſince he can do all this upon land much too ſtiff and wet for turnips; houſes his crops before the winter rains come on; and conſequently without doing any of that injury to his land which the turnip culture is known to entail, and from which even cabbages are not free. Thoſe who know the importance of winter food on a turnip farm, cannot but admit the magnitude of this object on wet ſoils."

297 Mr Marſhall's remarks

Mr Marſhall in his Rural Economy of Yorkſhire, has ſeveral very intereſting remarks on the potato. Its varieties, he ſays, are endleſs and tranſitory. The rough ſkinned Ruſſia potato, which was long a favourite of the Yorkſhire farmers, he is of opinion, has now no longer an exiſtence, more than many others which

298 on the curl.

flouriſhed for a time. "There is ſome reaſon to believe (ſays he) that the diſeaſe which has of late years been fatal to the potato crop in this and in other diſtricts under the name of CURLED TOPS, has ariſen from too long a continuance of declining varieties. Be this as it may, it appears to be an eſtabliſhed opinion here, that *freſh varieties*, raiſed from ſeed, are not liable to that diſeaſe." Our author, however, does not look upon this to be a fact abſolutely eſtabliſhed: though one inſtance fell under his obſervation, in which its removal was in all probability owing to the introduction of new varieties. It made its appearance between 40 and 50 years ago, and ſpread in ſome degree over the whole kingdom. In ſome places it continued but a ſhort time, ſo that its effects are almoſt forgotten. It is ſeldom obvious at the firſt coming up of the plants, but attacks them as they increaſe in ſize; the entire top becoming dwarfiſh and ſhrivelled as if affected by drought or loaded with inſects: they nevertheleſs live and increaſe, though ſlowly, in ſize; but the roots are unproductive. Some crops have been almoſt wholly deſtroyed by this diſeaſe. In Yorkſhire the Morelands are in a manner free from it, but the Vale is in ſome meaſure infected. Plants procured from the Morelands remain free from it in the Vale the firſt year; but, being continued, become liable to the diſeaſe. Where the attack has been partial, weeding out the diſeaſed plants as they failed, is ſaid to have had a good effect; and it is ſaid the Morelanders got rid of the diſeaſe by this means.

299 Method of raiſing varieties from ſeed.

In Yorkſhire ſome intelligent huſbandmen are acquainted with the method of raiſing potatoes from ſeed; which is as follows: "In autumn, when the apples are beginning to fall ſpontaneouſly, they are gathered by hand, and preſerved among ſand until the ſpring, when they are maſhed among the ſand or among freſh mould; ſeparating the ſeeds and mixing them evenly with the mould. As ſoon as the ſpring froſts are judged to be over, they are ſown in fine garden mould; and as faſt as the plants get into rough leaf, and are ſtrong enough to be handled without injury,

they

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they are transplanted into another bed of rich mould in rows, which are kept clean during summer. In autumn, bunches of small potatoes are found at the roots of these plants: varying in size, the first year, from a hazel nut to that of a crab. These being planted next spring, produce potatoes of the middle size; but they do not arrive at their fullest bulk until the third or fourth year. Where the use of the stove or the garden frame can be had, this process may be shortened. The seeds being sown within either of these early in the spring, the plants will be fit to be planted out as soon as the frosts are gone; by which means the size of the roots will be much increased the first year, and will in the second rise early to perfection."

Another account of the mode of raising potatoes from seed is given by Mr Henry Doby of Woodside Chapel, Allerton, near Leads. "Take the largest potato apples, of the kind you wish to renew, and string them on a very strong coarse thread, and hang them in a dry warm place till the latter end of February; when breaking them very small and washing them in several waters, the seed is to be separated from the fleshy part and skins; this done, it should be spread on brown paper; and when dry, sow it in the beginning of March, or sooner, on a hot-bed, in lines about nine inches asunder, and one-third of an inch deep, and very thin: water between the lines frequently, and when the plants are risen a little height, introduce fine rich earth between the lines to strengthen them. They should have air admitted frequently, the better to enable them to bear being removed into the open air as soon as the weather shall be sufficiently temperate. Before they are transplanted they should be plentifully watered to make them rise with a large ball at their roots; old rotten horse-dung and yellow moss are the best manures; plant them in trenches, as celery was formerly, with a space of four feet between the trenches, and 12 or 14 inches between each plant; as they grow up, draw the earth between the trenches to the stalks, but do not cover their tops. The ground, when brought to a level, should be dug, and the plants earthed until there are pretty deep trenches formed between the lines. With this treatment they will produce the first season from a pound weight to five pounds a plant; and many of the plants considerably more than a hundred potatoes a-piece; the produce of which for ten or twelve years after will be prodigious."

Annals of Agriculture, vol. xix.

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Dr Anderson's experiments.

In the 4th volume of the Bath Papers, Dr Anderson relates some experiments made on potatoes raised from seed. The first year they were of different sizes, from a pigeon's egg to that of a small pea. On planting these next year, it was invariably found, that the largest potatoes yielded the largest crop; and the same happened the third, when a few showed blossom; but not even these had bulbs equal to what would have been produced by very large potatoes. Whence he concludes, that it is impossible to assign any time in which these seedling potatoes will arrive at what is called *perfection;* but that it must depend very much on the nature of the soil and the culture bestowed upon them. From the practice of the Yorkshire farmers, however, and even from the experiments of the Doctor himself, it is evident, that potatoes raised in this way will at last grow to the usual size, as during the three years in which his experiments were continued they constantly increased in bulk. Dr Anderson likewise contends, that there is no reason for supposing that potatoes raised from bulbs in the ordinary way degenerate, or require to be renewed by seminal varieties; and he instances the universal practice of Britain and Ireland for a great number of years past. But this may be accounted for from an observation of Mr Marshall's, that varieties of potatoes, like those of corn, are partial to particular soils and situations. Hence, by transplanting all the different varieties of potatoes into all possible soils and situations, as has been done within this last century in the islands of Britain and Ireland, these varieties have continued for a much longer time than they would otherwise have done. In Yorkshire, Mr Marshall tells us, that "the old favourite sorts were driven until some of the individual plants barely produced their seed again." It is evident, therefore, that there is a necessity from time to time of renewing them from seed; though it deserves well to be considered whether it would not be more eligible to choose the seed from a plant in full vigour than from that which is so far degenerated that it can scarce produce its seed. "Potatoes raised from seed (says Mr Marshall) are a miscellany of endless varieties. Sometimes these varieties are planted miscellaneously; sometimes particular varieties are selected. In selecting varieties from seedling potatoes, two things are to be attended to; the intrinsic quality of the potato, and its productiveness. If these two desirable properties can be found in one plant, the choice is determined. To this species of attention and industry we are indebted for the many valuable kinds which have been and now are distributed throughout the island. It is observable, however, that varieties of potatoes, like those of corn, are partial to particular soils and situations. Hence the propriety of husbandmen raising potatoes from seed; as by this means they obtain, with a degree of moral certainty, a sort adapted to their own particular soils and situations. Whoever has attended closely to the work of taking up potatoes, must have observed the great inequality in the productiveness of individual plants. The difference in the produce of adjoining roots, where no disparity of soil can influence, will sometimes be three or four fold. Hence it is evident, that each variety has its *sub-varieties;* through whose means it can hardly be doubted the parent variety may be improved, and its continuance be prolonged. Thus the farmer has another mean in his power of improving the quality and productiveness of his potato crop, by improving varieties; or, in other words, selecting sub-varieties, superiorly adapted to his soil and situation."

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Whether potatoes degenerate.

Sir Archibald Grant, Bart. of Monymusk, in a letter to the conductors of the Farmer's Magazine, has recently made known a mode practised by him with a view to the saving of seed, and the obtaining an early crop of potatoes. "In spring 1800, (says that gentleman), from a scarcity of seed, I followed a method sometimes used by gardeners, for forcing early potatoes, pease, and beans, viz. that of planting them out upon a small dunghill, in order to make them come sooner forward, and afterwards transplanting them into the ground. This I did, after they had upon the dunghill risen to be good plants, and the leaves about an inch long.

Farmer's Magazine, 1802.

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How to obtain an early crop.

long. The dunghill was about three feet broad and 18 inches high, with from 2 to 3 inches of earth upon the top of it, and as long as held about a peck and three quarters of a peck of Aberdeenſhire meaſure (or 32lb. Dutch to the peck) of ſmall potatoes, cut into ſets, ſtuck as cloſe to each other as poſſible in the rows, and each row about two inches aſunder. On the 17th of April, they were put upon the dunghill; on the 2d of May they were in leaf; and on the 14th and 15th of May were planted out into the field; each plant 3 feet aſunder each way. On the 12th June, they were earthed up with the plough, and were afterwards dreſſed in the ordinary method. On the 1ſt Monday of October, being taken up, they produced from 14 to 16 bolls Aberdeen meaſure. In June I obſerved, that potatoes which had been planted in the ordinary way in other parts of the pariſh in the middle of April were ſcarcely appearing above ground when theſe were ſo high as to require being earthed up with the plough; ſo that ſix weeks were gained in growth by this method."

303 Potatoes planted by ſcooping out the eyes.

During the late great dearth of all kinds of proviſions, a plan was adopted with a view to ſave for food a part of the potatoes uſed as ſeed, which conſiſted of not cutting them into pieces with one or more eyes in each piece, as uſual, but of ſlightly ſcooping out the eyes, which in that ſtate were planted while the greater part of the potato was preſerved for the uſe of man or cattle. This mode of planting potatoes was ſucceſsful with a great number of perſons; but in ſome inſtances, where the ground was not in an excellent ſtate of preparation, the crop is underſtood to have been more defective than when the uſual mode was adopted of cutting off large pieces of the potato along with the eye. The point, however, about the utility of this mode of practice muſt ſtill be conſidered as doubtful or worthy of farther inveſtigation. We are rather diſpoſed to think that the practice of ſlightly ſcooping out the eye will not ultimately prove beneficial, becauſe in ordinary caſes the plant will be left deſtitute of due nouriſhment from the parent root at too early a period of its growth, and before it is completely capable of deriving its ſubſiſtence from the ſoil around it; in the ſame manner, and for the ſame reaſon, that light ſeed is apt to produce a light crop of grain. This objection may not indeed hold good with regard to potatoes planted on a very fine ſoil, or upon a hot-bed, for tranſplanting after the manner adopted by Sir Archibald Grant above mentioned. But on poor lands, where the ſtrength of the young plants is more ſeverely tried, any defect in the ſize of the root planted will probably always be productive of bad effects.

2. Turnip.

304 Culture of turnip.

Turnip delights in a gravelly ſoil; and there it can be raiſed to the greateſt perfection, and with the leaſt hazard of miſcarrying. At the ſame time, there is no ſoil but will bear turnip when well prepared.

No perſon ever deſerved better of a country, than he who firſt cultivated turnip in the field. No plant is better fitted for the climate of Britain, no plant proſpers better in the coldeſt part of it, and no plant contributes more to fertility. In a word, there has not for two centuries been introduced into Britain a more valuable improvement.

Of all roots, turnip requires the fineſt mould; and to that end, of all harrows froſt is the beſt. In order to give acceſs to froſt, the land ought to be prepared by ribbing after harveſt, as above directed in preparing land for barley. If the field be not ſubject to annuals, it may lie in that ſtate till the end of May; otherwiſe, the weeds muſt be deſtroyed by a braking about the middle of April, and again in May, if weeds ariſe. The firſt week of June, plough the field with a ſhallow furrow. Lime it if requiſite, and harrow the lime into the ſoil. Draw ſingle furrows with intervals of three feet, and lay dung in the furrows. Cover the dung ſufficiently, by going round it with the plough, and forming the three feet ſpaces into ridges. The dung comes thus to lie below the crown of every ridge.

305 Seaſon and method of ſowing.

The ſeaſon of ſowing muſt be regulated by the time intended for feeding. Where intended for feeding in November, December, January, and February, the ſeed ought to be ſown from the firſt to the 20th of June. Where the feeding is intended to be carried on to March, April, and May, the ſeed muſt not be ſown till the end of July. Turnip ſown earlier than above directed, flowers that very ſummer, and runs faſt to ſeed; which renders it in a great meaſure unfit for food. If ſown much later, it does not apple, and there is no food but from the leaves.

Though by a drill plough the ſeed may be ſown of any thickneſs; the ſafeſt way is to ſow thick. Thin ſowing is liable to many accidents, which are far from being counterbalanced by the expence that is ſaved in thinning. Thick ſowing can bear the ravage of the black fly, and leave a ſufficient crop behind. It is a protection againſt drought, gives the plants a rapid progreſs, and eſtabliſhes them in the ground before it is neceſſary to thin them.

The ſowing turnip broad-caſt is almoſt univerſal in England, and common in Sotland, though a barbarous practice. The eminent advantage of turnip is, that, beſides a profitable crop, it makes a moſt complete fallow; and the latter cannot be obtained but by horſe-hoeing. Upon that account, the ſowing turnip in rows at three feet diſtance is recommended. Wider rows anſwer no profitable end, ſtraiter rows afford not room for a horſe to walk in. When the turnip is about four inches high, annual weeds will appear. Go round every interval with the ſlighteſt furrow poſſible, at the diſtance of two inches from each row, moving the earth from the rows toward the middle of the interval. A thin plate of iron muſt be fixed on the left ſide of the plough, to prevent the earth from falling back and burying the turnip. Next, let women be employed to weed the rows with their fingers; which is better, and cheaper done, than with the hand-hoe. The hand-hoe, beſide, is apt to diſturb the roots of the turnip that are to ſtand, and to leave them open to drought by removing the earth from them. The ſtanding turnip are to be at the diſtance of twelve inches from each other: a greater diſtance makes them ſwell too much; a leſs diſtance affords them not ſufficient room. A woman ſoon comes to be expert in finger-weeding. The following hint may be neceſſary to a learner. To ſecure the turnip that is to ſtand, let her cover it with the left hand; and with the right pull up the turnip on both ſides. After thus freeing the ſtanding turnip, ſhe may ſafely uſe both hands. Let the field remain in this ſtate till the appearance of new annuals make a ſecond ploughing

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ploughing neceſſary; which muſt be in the ſame furrow with the former, but a little deeper. As in this ploughing the iron plate is to be removed, part of the looſe earth will fall back on the roots of the plants; the reſt will fill the middle of the interval, and bury every weed. When weeds begin again to appear, then is the time for a third ploughing in an oppoſite direction, which lays the earth to the roots of the plants. This ploughing may be about the middle of Auguſt; after which, weeds riſe very faintly. If they do riſe, another ploughing will clear the ground of them. Weeds that at this time riſe in the row, may be cleared with a hand-hoe, which can do little miſchief among plants diſtant twelve inches from each other. It is certain, however, that it may be done cheaper with the hand (G). And after the leaves of turnips in a row meet together, the hand is the only inſtrument that can be applied for weeding.

In ſwampy ground, the ſurface of which is beſt reduced by paring and burning, the ſeed may be ſown in rows with intervals of a foot. To ſave time, a drill-plough may be uſed that ſows three or four rows at once. Hand-hoeing is proper for ſuch ground; becauſe the ſoil under the burnt *ſtratum* is commonly full of roots, which digeſt and rot better under ground than when brought to the ſurface by the plough. In the mean time, while theſe are digeſting, the aſhes will ſecure a good crop.

306 Properties of different ſorts of turnip.

In cultivating turnips to advantage, great care ſhould be taken to procure a good, bright, nimble, and well-dried ſeed, and of the beſt kinds.

The Norfolk farmers generally raiſe the oval white, the large green-topped, and the red or purple-topped kinds, which from long experience they have found to be the moſt profitable.

The roots of the green-topped will grow to a large ſize, and continue good much longer than others. The red or purple-topped will alſo grow large, and continue good to the beginning of February; but the roots become hard and ſtringy ſooner than the former.

The green-topped growing more above ground, is in more danger of ſuſtaining injury from ſevere froſts than the red or purple, which are more than half covered by the ſoil; but it is the ſofteſt and ſweeteſt, when grown large, of any kind. We have ſeen them brought to table a foot in diameter, and equally good as garden turnips.

Turnips delight in a light ſoil, conſiſting of ſand and loam mixed; for when the ſoil is rich and heavy, although the crop may be as great in weight, they will be rank, and run to flower earlier in ſpring.

307 Obſervations with regard to ſeed.

Turnip-ſeed, like that of grain, will not do well without frequent changing. The Norfolk ſeed is ſent to moſt parts of the kingdom, and even to Ireland: but after two years it degenerates; ſo that thoſe who wiſh to have turnips in perfection ſhould procure it freſh every year from Norwich, and they will find their account in ſo doing. For from its known reputation, many of the London ſeedſmen ſell, under that character, ſeed raiſed in the vicinity of the metropolis, which is much inferior in quality.

When the plants have got five leaves, they ſhould be hoed, and ſet out at leaſt ſix inches apart. A month afterward, or earlier if it be a wet ſeaſon, a ſecond hoeing ſhould take place, and the plants be left at leaſt 14 inches diſtant from each other, eſpecially if intended for feeding cattle; for where the plants are left thicker, they will be proportionably ſmaller, unleſs the land is very rich indeed.

308 Methods of culture in Norfolk.

Some of the beſt Norfolk farmers ſow turnips in drills three feet aſunder, and at a ſecond hoeing leave them a foot apart in the rows. By this means the trouble and expence of hoeing is much leſſened, and the crop is of equal weight as when ſown in the common method. The intervals may eaſily be cleared of weeds by the horſe-hoe.

Communications to the Board of Agriculture, vol. ii.

There has been laid before the Board of Agriculture, the reſult of ſome intereſting experiments, which we ſhall here ſtate, that were made by Mr W. Jobſon of Turvelaws, with a view to aſcertain the comparative merits of the two modes of rearing turnips by drill or broad-caſt.

309 Culture of turnip by drill and broad-caſt compared.

The trial was made upon a part of a field of 15 acres ſown in the month of June 1797. "The whole field, ſays Mr Jobſon, was in equal tilth, was manured as equally as poſſible immediately before ſowing with rotted fold-yard dung, at the rate of 17 cart loads per acre, each load containing about 28 Wincheſter buſhels; and in order to make the experiment perfectly fair, there were breadths of land of 20 yards each, ſown in broad-caſt and drills alternately, throughout the whole field. Part of the drills on one-bout ridges of 27 inches each, with the dung laid immediately underneath, where the row of ſeed was depoſited; the reſt of the drills upon a level ſurface, were ſown by Mr Bailey's machine at 21 inches diſtance. The produce per acre is calculated from the weight of four ſquare perches, or the fortieth part of a ſtatute acre of each, having firſt cut off the tails, or fibrous part of the root, and thrown them aſide as unfit for food, and then taken the weight of the tops and roots ſeparately.

"It is neceſſary to obſerve, that this field of turnip was but a middling crop, having been much hurt immediately after the firſt hoeing, by the *grub* (a ſmall worm which deſtroys the root), particularly the drilled part of the field, which, having had the plants ſet out, at the diſtances at which they were intended to remain before the grub ſeized them, was on that account rendered too thin and otherwiſe much injured; notwithſtanding which, it was found that thoſe on the one-bout ridges exceeded the others in weight; alſo, that theſe parcels of turnips were taken from an inferior (though not the worſt) part of the field, and may therefore be deemed to be a pretty fair average of the whole;

(G) Children under thirteen may be employed to weed turnips with the fingers. We have ſeen them go on in that work with alacrity; and a ſmall premium will have a good effect. For boys and girls above thirteen, a hand-hoe adapted to their ſize is an excellent inſtrument: it ſtrengthens the arms amazingly. In driving the plough, the legs only are exerciſed; but as the arms are chiefly employed in huſbandry, they ought to be prepared beforehand by gentle exerciſe.

whole: there were alſo three other portions weighed, which were taken from a part of the field where the roots were larger, and a fuller crop, with a view to aſcertain what might have been expected, had not the grub ſeized them in the manner deſcribed; but unfortunately the paper containing their weight has been loſt or miſlaid, which puts it out of my power to furniſh you with it. There was alſo an account taken of the number (but not the weight) of loads which were produced upon a few acres of the worſt part of the field which was in favour of the broad-caſt, in the proportion of ten of broad-caſt to nine of thoſe drills on one-bout ridges, and eight of Mr Bayley's drill.

"From this experiment (though defective from the reaſons aſſigned) we have reaſon to conjecture, though not to form a concluſion, that a heavier crop may be raiſed by ſowing in drills at 27 inches diſtance with the dung immediately beneath the plants, than in broad-caſt or in drills at 21 inches on a level ſurface: but whether the advantage ariſes from the ſituation in which the dung is depoſited, or from their having a freer circulation of air, or from both theſe united, it remains for future and repeated experiments to decide. Notwithſtanding this, it will be found, that each of theſe methods poſſeſſes peculiar advantages and diſadvantages, according to ſituations and circumſtances; the reaſons for which I deduce from the obſervations I have made reſpecting this as well as former crops. In the firſt place, the one-bout ridges I think preferable for early ſowing, and eating off, through the winter months, even ſo late as the month of February, as they are more eaſily procured for food for cattle in deep ſnows; alſo in ſituations where it is difficult to procure a ſufficient number of experienced hoers, thoſe under the drill ſyſtem can be more eaſily managed and at leſs expence, as boys and girls may be readily taught to ſet out the plants with great regularity in very little time; but turnips under this ſyſtem are liable to the inconvenience of being more apt to be injured by ſevere froſts from their high expoſure. Another inconvenience I have alſo obſerved on wet and heavy lands, more eſpecially with little declivity, that although there ſhould, and poſſibly may, be a larger crop produced thereby, yet the land will unavoidably be ſo much poached by carrying them off, that the ſucceeding crop of corn will be leſſened more than the extra value of the turnips will compenſate. When it is attempted to raiſe turnips upon land of this deſcription, it will be found more advantageous to form it into ridges of ſufficient height to carry off the water with eaſe into the water furrows, and of ſufficient breadth (ſuppoſe fifteen feet) to allow a cart to paſs along them freely, without forcing the earth in to choke up theſe furrows. The turnips may be ſown either in broad-caſt or in drills, upon the ſurface of theſe ridges. If the land is addicted to annual weeds, they will be beſt in drills, which will expedite the hoeing; but if not, or if they be late in ſowing, or if the land be ſubject to the grub, broad-caſt will generally be found to produce a more certain crop, as they can be left ſo near to each other at the firſt hoeing as to admit of being thinned, and thereby give the opportunity of taking out unhealthy plants at the ſubſequent hoeings, and alſo that they grow more vigorouſly between the firſt and ſecond hoeings."

The reſult of the experiment here alluded to, is ſtated in the following manner:

Comparative Weight of ſix portions of Turnips, which were part of a Field of fifteen Acres: the whole of which was Sown in the Month of June 1797, as an experiment between the Drill and Broad-caſt ſyſtems.

	Time of weighing.	Number upon four ſquare perches.	Weight on four ſquare perches, or the 40th part of an acre. ROOTS. Cwt. qr. lb.	TOPS. Cwt. qr. lb.	Weight per ſtatute acre. Tons cwt. qr. lb.	Average weight of each turnip. lb. oz.	Average diſtance of each turnip.
N° I. Drilled on one-bout ridges, at 27 inches diſtance.	January	354	8 1 1	1 1 3	19 1 0 20	3 0¼	16½ in. by 27 in.
II. Drilled with Mr Bayley's machine, on a level ſurface, at 21 inches diſtance.	ditto	428	7 1 15¼	1 1 5¼	17 7 1 8	2 4¼	17 in. by 21 in.
III. Broad-caſt.	do.	568	7 2 12½	1 0 11¼	17 8 1 26	1 11½	16¾ each way.
IV. Drilled on one-bout ridges, at 27 inches diſtance.	Mar. 2.	334	8 3 0	1 1 22	20 7 3 12	3 6½	17 by 27 in.
V. Broad-caſt. Theſe and the preceding were round white turnips.	do.	628	8 2 22	1 1 8	20 0 2 24	1 12½	16 each way.
VI. Broad-caſt (Red).	do.	561	6 3 26½	2 3 5	19 11 1 0	1 15¾	16½ each way.

"By noting the average diſtance of each turnip, as is done in the laſt column, is intended to ſhow, at one view, how many plants there were wanting in the drills to have made them a full crop; for, if 550 be ſtated as a medium number in a full crop, upon the 40th part of an acre, they will be found to occupy a ſpace of 17 inches each way in broad-caſt, 10½ by 27 inches on the one-bout ridges, and 13½ by 21 inches of thoſe

drilled

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drilled on the level furface; from whence may be eafily feen, how much thofe were wider in the rows than they ought to have been."

Great quantities of turnips are raifed in Norfolk every year for feeding black cattle, which turn to great advantage.

310 Value as food for cattle.

It is well known, that an acre of land contains 4840 fquare yards, or 43,560 fquare feet; fuppofe then that every fquare foot contains one turnip, and that they weigh only two pounds each on an average, here will be a mafs of food, excellent in kind, of 46 tons *per* acre, often worth from four to five guineas, and fometimes more.

Extraordinary crops of barley frequently fucceed turnips, efpecially when fed off the land. In feeding them off, the cattle fhould not be fuffered to run over too much of the ground at once, for in that cafe they will tread down and fpoil twice as many as they eat. In Norfolk, they are confined by hurdles to as much as is fufficient for them for one day. By this mode the crop is eaten clean, the foil is equally trodden, which if light is of much fervice, and equally manured by the cattle.

A notion prevails in many places, that mutton fattened with turnips is thereby rendered rank and ill tafted; but this is a vulgar error. The beft mutton in Norfolk (and few counties have better) is all fed with turnips. It is by rank paftures, and marfhy lands, that rank mutton is produced.

If the land be wet and fpringy, the beft method is to draw and carry off your turnips to fome dry pafture; for the treading of the cattle will not only injure the crop, but render the land fo ftiff, that you muft be at an additional expence in ploughing.

311 Method of preferving turnips.

To preferve turnips for late fpring feed, the beft method, and which has been tried with fuccefs by fome of the beft Englifh farmers, is, To ftack them up in dry ftraw; a load of which is fufficient to preferve 40 tons of turnips. The method is eafy, and is as follows:—

After drawing your turnips in February, cut off the tops and tap roots (which may be given to fheep), and let them lie a few days in the field, as no weather will then hurt them.

Then, on a layer of ftraw next the ground, place a layer of turnips two feet thick; and then another layer of ftraw, and fo on alternately, till you have brought the heap to a point. Care muft be taken to turn up the edges of the layers of ftraw, to prevent the turnips from rolling out; cover the top well with long ftraw, and it will ferve as a thatch for the whole.

In this method, as the ftraw imbibes the moifture exhaled from the roots, all vegetation will be prevented, and the turnips will be nearly as good in May as when firft drawn from the field. If ftraw be fcarce, old haulm or ftubble will anfwer the fame purpofe.

But to prevent this trouble and expence, perhaps farmers in all counties would find it moft to their intereft to adopt the method ufed by our neighbours the Norfolk farmers, which is, to continue fowing turnips to the latter end of Auguft; by which means their late crops remain good in the field till the latter end of April, and often till the middle of May.

The advantages of having turnips good till the fpring feed is generally ready, are fo obvious, and fo great, that many of the moft intelligent farmers (although at firft prejudiced againft the practice) are now come into it, and find their account in fo doing.

312 Their culture faid to be generally attended with no profit.

Turnips have long been in fuch general ufe as food for cattle, that the profit on raifing them might be reafonably thought to be altogether certain; neverthelefs, Mr Young, in the paper already quoted, informs us, that "turnips dunged for are univerfally a lofing crop; for if they are ftated from 30s. to 40s. an acre, their value does not amount to the dung alone which is fpread for potatoes; yet the latter pays that dung, all other expences, and leaves a profit fometimes confiderable. I admit that turnips fed upon the land will prepare better for corn; but that is by no means the queftion. Would not the dung raifed in the farm-yard by the confumption of the potatoes, fuppofing it fpread on the potato acre, make that produce more than the turnip one? I have no doubt but it would give a fuperiority. But turnips are liable to great failures, and cannot be relied on late in the fpring: potatoes may; and are applicable to ufes to which the other root cannot be applied."—In the fecond volume of the Bath Papers, p. 101. we have a comparative account of the value of turnips, turnip-rooted cabbage, and lucerne, as food for cattle. The refult of this writer's obfervations is, that "when fheep are allowed as many turnips as they can eat (which fhould always be the cafe when they are fattening), they will, on an average, eat near 20 pounds each in 24 hours. An acre of turnips twice hoed, will, if the land be good, produce about fifty tons; which will, on the above calculation, maintain 100 fheep 52 days. The fheep mentioned weigh 20 pounds per quarter. An acre of turnip-rooted cabbage will maintain 100 fheep for a month, and fometimes five weeks; but an acre of Scots cabbages will maintain 200 fheep a full month." The number fed by lucerne is not determined.

313 Compared with other vegetables as food for cattle.

314 The fly occafions the great inconvenience in turnip culture.

The greateft difadvantage which attends a crop of turnips, is their being fo ready to be damaged by the fly, which fometimes deftroys them fo completely, that they muft be fown over again two or three times the fame feafon, and even this without any certainty of fuccefs. Innumerable methods of avoiding this evil have been projected, which may all be reduced to the following claffes: 1. Steeping the feed in certain liquids. 2. Fumigation of the fields with the fmoke of certain herbs. 3. Rolling. 4. Strewing foot, lime, afhes, &c. on the furface of the ground. It is very difficult, however, to determine, with any degree of certainty, whether remedies of this kind are effectual or not; becaufe fometimes the turnips are not injured though no precaution has been made ufe of: and when this happens to be the cafe, after the ufe of any fuppofed preventive, the prefervation of the crop is afcribed to the ufe of that preventive, whether it be really efficacious or not. The virtues of fteeps feem to have been fully afcertained by Mr Winter Charlton near Briftol, of whofe experiments an account is given in the Tranfactions of the Society for Encouraging Arts, vol. v. The feeds were of the Dutch kind, fowed on beds in the kitchen garden in drills, about twelve inches diftant, an inch and a half deep, on the 11th of May 1786. The beds had been prepared with rotten dung in May 1785, and afterwards fown with cabbages. The quality of the turnips is exhibited in the following table;

315 Whether fteeps for turnip-feed be of any ufe.

thee

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the best being marked 1; and those of inferior quality, 2, 3, &c. The observations were taken on the 26th of June.

Seed without any preparation, - -	1
steeped in train oil, flourished extremely,	
steeped in linseed oil, somewhat inferior,	1
Seed mixed with soot and water, - -	2
with drainings of a dunghill, -	2
with elder and barton draining, -	2
with soot, - - -	3
with elder leaf juice, - -	3
with elder and barton draining, soot being sowed over the covered drills,	3
with ditto, and lime sowed over the drills, - - -	3
sowed with soot scattered over, and then covered, - - -	3
with barton draining, - -	4
an elder bush drawn over when the plants appeared, - -	4
with stale human urine, very few plants appeared,	
with slaked lime scattered over, and then covered, very few plants appeared,	
with elder, barton-draining, and slaked lime, very few plants appeared,	
with lime and barton-draining did not vegetate.	

Another set of experiments was made with the green Norfolk turnip, drilled an inch and a half deep, the rows one foot distant, on beds eight feet three inches long, and two feet wide; half a drachm of seed allowed for each bed, steeped and mixed with various substances like the former. The seeds were drilled upon unmanured ground on the 20th of June 1786, and the observation made on the 17th of July. None of the beds were found free from the ravages of the fly; but the seeds which had been steeped in train oil and linseed oil were much more free from this injury than the others. The linseed oil, as in the former experiment, was found inferior to the train oil, which was supposed to have been owing to its being kept in a bottle that had formerly held oil of turpentine. The leaves of the steeped seeds were of a much darker green than the others, appeared twice as thick in bulk and luxuriancy, and the plants were considerably larger than those of the other kinds. The substances mixed with the rest were soapers ashes, wood ashes, pounded gunpowder, brimstone, slaked lime, soot, barton-draining; sometimes mixed together in various proportions, and sometimes with the addition of a portion of sifted mould.

These experiments show, that no dependence can be had on steeps or mixtures of any kind with the turnip-seed; though the train oil and linseed oil seem greatly to have forwarded the vegetation of the plant. It does not appear that fumigation has ever been tried; nor indeed does it seem easy to be tried in such a manner as might ensure success.—In the fourth volume of the Bath Papers, Mr Gullet of Devonshire gives such directions for performing the operation as he thinks would be productive of success.—In a preceding paper he had explained the good effects of fumigating orchards; but

316 Mr Gullet's directions for fumigation.

the case with these must be very considerably different from a field of turnips. The trees in an orchard are elevated above the ground, and the smoke naturally ascends, and is blown along their tops: but in fumigating a large field of turnips, it must creep along the ground in such a manner as is by no means agreeable to its nature; and without any excessive degree of labour, as well as a vast quantity of burning materials, there cannot be the least hope of success. Mr Gullet's directions are as follow: "If the turnip-ground be spaded and burnt, or the weeds, &c. burnt without spading, the fumigation thereby may suffice to chase such of the winged tribe from thence as are then there; but in all cases, when the field is ploughed and ready for sowing, let heaps be made at different places and intervals round by the hedges and boundaries of the turnip-ground, and some few scattered through the field; then, as soon as the seed is sown, let the heaps on the windward side and the scattered ones be lighted and kept smothering during the continuance of the wind in that quarter; the less the fire, and the more the smoke, the better. Should the wind happen to shift, those heaps on the quarter it shifts to must then be lighted and kept smothering in like manner; so that during the growth of the tender turnip leaf, and until it becomes rough and out of all danger, this fumigation and smoke, over and across the field, must be continued from one quarter to the other; which I venture to assert, will effectually deter and prevent any winged insect tribe from approaching the turnip-ground: nay more, if there already, it would most completely drive them from thence, as such delicately formed insects (which can only feed on the most tender leaf) would be ill able to continue long in such a smother of fire and smoke. The consequence is obvious and certain, that if the fly be kept from approaching the field, the turnip-crop is safe; and few, I believe, will disagree with me, that *prevention is better than remedy*."

Our author does not say that he has ever tried this method with turnips; but lays great stress upon his success in a similar experiment with cabbages, in order to preserve them from the caterpillar. To make the matter more sure, however, he recommends the trailing of a bush of elder over the turnip field at the time of harrowing or brushing in the seed: but this remedy has by numberless experiments been found insignificant, and by those above related seems even to be pernicious: so that whatever good effects we can expect from this method, must depend on the fumigation alone; and even this is attended with very great uncertainties, as has already been observed.

317 Of rolling.

Rolling promises to be of service when the young turnips are attacked by snails, which frequently destroy them; but it cannot be supposed to have much effect in destroying flies, these being too numerous and too minute to be effectually crushed by the roller: and indeed, though this has been frequently recommended, we have no decisive proofs of its having ever been attended with any good effect.

The strewing of soot, lime, ashes, &c. upon the ground, have been determined ineffectual by the experiments already related, at least when applied before the turnips come up; and there seems to be little hope of their proving more effectual even when applied after the crop has appeared above ground. We may argue indeed

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indeed *à priori* about the taste or smell of soot, lime, &c. being disagreeable to insects; but of this we have no proof; and even though this were the case, the leaf soon emerges from under this covering, or the insects will feed on the under part of the leaves, where these substances cannot lie. It is evident, therefore, that very little can be expected from any of the methods hitherto proposed either by way of cure or prevention. The more probable methods are,

318 Early sowing recommended.

1. To sow the turnips at such a season of the year that they may be well grown before the fly makes its appearance. In the Bath Papers, vol. iv. p. 132. Mr Wimpey observes, that in order to procure food for their cattle in the spring before the grass is grown, farmers are obliged to postpone the sowing of turnips beyond the natural time of vegetation; but were turnips to be sown in April, as soon as the season would permit, it is very probable that there would be as great a crop of them as of other vegetables usually sown in these months. On account of the delay in sowing, however, for the reason already mentioned, the success of the farmer becomes exceedingly precarious, unless he is so fortunate as to have a few rainy days, or cloudy weather and frequent showers, soon after the seed is sown: and this our author supposes to be the true reason why the turnip is a more uncertain article than any other. But though speculations of this kind have a great show of probability, there is not any experiment hitherto published, even by our author himself, by which the truth of the above conjecture can be absolutely ascertained. Our author, however, is of opinion, that none of the common methods proposed can answer any good purpose, farther than as by means of them the vegetation of the plant may be invigorated. Mr Wimpey recommends ashes, soot, or a rich compost of lime and dung, used in sufficient quantities; but the method of using them is, either to sow them with the seed, or rather by themselves immediately before, and to harrow them well in, that they may be completely incorporated with the soil. This for the most part would so invigorate and encourage the growth of the plants, as to be an overmatch for the most vigorous attacks of the fly.

319 Sowing a great quantity of seed.

2. Another method proposed for securing turnips from the fly, is by sowing such a quantity of seed as will be more than sufficient for the consumpt of the insects. This we find recommended in a letter to the Bath Society, by a gentleman-farmer in Essex, vol. ii. p. 238. His method is to make the land clean and fine as soon as the season will permit, and to sow four pints per acre. It may be objected, that if the fly does not take them, the plants will stand so thick, that they cannot easily be hoed; but this may be obviated by harrowing them first, which will make them fit for the hoe. There can be no expectation of a crop if the fly takes them when only a pint of seed is sown per acre; but this gentleman remarks, that he has not in any one instance missed of a crop when he sowed four pints; because, though the fly has sometimes destroyed more than one half, and much damaged the other, still there was a sufficient number left behind. He also agrees with other of the Society's correspondents, that the ground should be well dunged and manured previous to the sowing of turnips, as this makes them grow vigorously, so that they quickly get into the rough leaf, in which state the fly will not touch them.

320 Manuring in autumn preferable to spring manure.

In the same volume, a gentleman of Norfolk remarks, that manuring the ground in autumn for turnips is preferable to the doing so in spring. This discovery he made in consequence of the following accident.—"A neighbouring farmer, not having a sufficient quantity of manure for all his turnip land, was under the necessity of sowing four acres unmanured. The effect was, that the turnips on the manured part of the land were mostly eaten off by the fly, while four acres unmanured escaped without injury." In consequence of having observed this, the gentleman made a similar experiment, by manuring five acres well for turnips, and tilling three acres and a half in the usual way without any manure. The manured crops were almost all destroyed by the fly, so that he was obliged to sow most of the land over again. The three acres and a half which had no manure were entirely free from injury, though the plants were much smaller than those of the manured ground which came up. Not content with this trial, however, he repeated the experiment, by manuring six acres of wheat stubble in autumn, ploughing it in immediately, and leaving it to incorporate with the earth during the winter: the turnips which grew upon this were as large as if the ground had been manured in the spring. This experiment was repeated with surprising success in two succeeding years; whence he infers, that the fly is either engendered in the new dung or enticed by it. But when the manure is laid on in autumn it loses its noxious qualities, though it still retains its nutritive ones.—This conclusion, however, does not appear to be well founded; for it is certain from undoubted experience, that turnips which have been well manured in the common way, have sometimes escaped any injury; while others, which have got no manure at all, have been almost totally destroyed. Another material advantage, however, which this correspondent observes is to be derived from manuring in autumn is, that all the seeds contained in the manure, and which are of course carried to the land with it, vegetate almost immediately, and are mostly killed by the cold of the succeeding winter, while the few that remain can scarce escape destruction from the ploughshare.

321 Mr Wimpey's opinion of sowing a great quantity of seed.

Mr Wimpey is also of opinion, that it is proper to sow a large quantity of seed; but thinks two pounds will be sufficient for an acre. A few ounces indeed would be sufficient to stock the land; but as the article is so precarious, he thinks it by far the safest way to allow seed in plenty, and reduce the plants afterwards by harrowing. He observes also, that it is of great consequence to have seed both good in quality and of the best species. He prefers the large and green topped, as being the most sweet and juicy; others give the preference to the red or purple-topped, as being hardier: but at any rate, the seed from the largest and finest transplanted turnips, of whatever sort, is greatly to be preferred, even though it should cost double or treble the price. Such as is sold by the seedsmen in London he found generally of a mixed kind, and often in great part not worth cultivating. "Whether plants from new or old seed are most secure from the depredations of the fly (says he), is perhaps a question which cannot be easily determined even by experiments; for concomitant circumstances are frequently so much more operative and powerful, as to render the difference between

322 Of the quality of the seed.

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tween them, if there be any, imperceptible. It is, however, known to every practical man, that new feed fprouts or vegetates feveral days before old; and I think more vigoroufly: and it is equally well known, that the healthy and vigorous plants efcape the fly, when the ftinted and fickly feldom or never efcape it. Hence it would feem, that new feed, *cæteris paribus*, is more fecure from the fly than old; and for my own ufe I would always prefer it."

323 Of fowing turnips with grain.

3. The fowing of turnips along with grain.—This, of all others, feems to be the moft eligible and efficacious. In the fecond volume of Bath Papers, p. 210. a Hertfordfhire correfpondent gives an account of the fuccefs of an experiment of drilling turnips with wheat. A fmall field of fpring-wheat was drilled in rows two feet apart; and in the month of May turnips were fown by hand in the intervals. They came up very well, and were thinned once by the

324 With wheat.

hoe. The crop of wheat turned out better than another field of the fame foil fown broad-caft in autumn, though it ripened fomewhat later. The turnips were no other way injured by cutting it, than having fome of the large leaves trodden down by the reapers. After harveft the weeds were cut up round the turnips with a hand-hoe, and they grew very large and vigorous. They were of the purple and white long kind, and the crop proved nearly as good as the fame land produced in common. An excellent crop of barley and clover was got from the fame field afterwards.

325 Mr Anderdon's experiments of fowing them with beans.

In the third volume of the fame work we find an account of feveral fuccefsful experiments in fowing turnips between rows of beans. The advantages of this method are ftrongly fet forth by R. P. Anderdon, Efq; who made fome of the experiments, and are as follow: "1. You may have a crop of beans and turnips on the fame field the fame year. 2. The bean crop being well horfe-hoed, no ploughing is wanted for turnips, for which the beft Norfolk farmers give five ploughings. 3. It is hoed cheaper, more effectually, and confequently more profitably, than in any other way. 4. The ground is kept clean from weeds. 5. It is in order for a Lent crop the fucceeding year with one earth. 6. The ground is kept in heart, if not improved, by fallowing your alleys. 7. It brings the plant to perfection in poor ground, where it would not become fo otherwife. 8. It doubles the crop in any ground which Mr Anderdon has had experience of. 9. You have the crops more within your own power in this than in any other method, let the feafons turn out as they will. 10. You may have on the fame ground a bean and turnip crop annually, if the land be fuitable, and you think proper. 11. The clay farmer, by this mode, renders land which is naturally unfit for turnips, fo free and open by feafonable horfe-hoeings, that it will bring this ufeful plant to great perfection."

326 Objections by the Bath Society.

On this paper the fociety made fome remarks, and ftated the following objections: 1. The fame foil cannot be proper for both crops. Scotch cabbages are more adapted for a bean foil; and they wifhed him to repeat the experiment with cabbages inftead of turnips betwixt his beans. 2. The Norfolk farmers rarely ufe more than three ploughings for turnips, inftead of five, as Mr Anderdon reprefents, unlefs the ground be full of couch grafs. 3. They think him too fanguine in his expectations of having double crops on the fame field. 4. Nothing renders a clay foil fo free and open as to have it expofed to frofts and fnow by being laid up in high ridges in January and February; but, on Mr Anderdon's plan, this cannot be done, unlefs the turnips are leffened in value by being fed off in autumn.

327 Mr Anderdon's reply.

Thefe ftrictures were fent to Mr Anderdon before the papers were printed, but did not make any alteration in his opinion; and he replied to the following purpofe:

1. *The fame foil cannot be proper for beans and turnips*, &c.—Granted.—But had Mr Anderdon adhered rigoroufly to this rule, he would have fowed no turnips at all, not having on his farm any foil altogether proper for that crop; "but (fays he) while I can get in fingle rows, four feet afunder or more, from half a dozen to half a fcore tons of turnips per acre, after, or rather between, a crop of beans in my heavy lands, I fhall feel that product here more beneficial than to drop the mode. I believe the medium of the two, fo far as I can judge by the eye or get information, to be fuperior to the average produce of prepared fallow turnip crops in 10 miles round me."—On this the Society make the following remarks: "The queftion here is, Whether, if inftead of turnips, Mr Anderdon had planted his beans two feet diftance only, the extra produce of his crop would not have exceeded in value that of his turnips? We think they would, as thefe intervals would freely admit his horfe-hoe between the beans."

Mr Anderdon then proceeds to acquaint the committee, that he had tried the experiment as they wifhed with Scotch cabbages inftead of turnips betwixt the rows of beans; but the crop of the turnips was fo much preferable, that he found himfelf inclined to fuppofe the cabbage would not get to fo great perfection there as to be profitably introduced on a large fcale, for want of the great quantity of dung neceffary for that crop, and which could not be procured in that part of the country. He further remarks in favour of turnips, that they have an abundance of very fmall lateral fibrous roots, which run as far in fearch of food, and feed as ravenoufly where they can penetrate, as thofe of almoft any other vegetable; and the plant certainly derives more nourifhment from thofe than from its tap-root (H). Thofe fine fibrous roots, almoft imperceptible to the eye, iffue chiefly from the apple or body of the turnip, and get into the richeft part of the foil near the furface, and will bring the plants to a confiderable magnitude in heavy lands adapted to beans, when mellowed by the horfe-hoe. Some of his turnips weighed ten pounds each: and if he could have only two fuch turnips on every fquare yard, it would be at the rate of 43 tons per acre.

2. *The Committee doubt of the poffibility of doubling the crop.* Mr Anderdon gives the following explanation. "I

(H) Here the fociety remark, that this is not the cafe with thofe kinds of turnips which grow chiefly above ground, and which are generally the beft crops, and moft capable of refifting the frofts,

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"I have made many comparative trials on turnips between this mode and broad-caſt ſowing, and always found on *my ground* the horſe-hoed crops the beſt. But here, in denoting the benefits of the horſe-hoe by its *doubling* a crop, I wiſh to be underſtood, that if, *in ſoils like mine*, a crop be drilled, leaving proper intervals for horſe-hoeing, and one part be horſe-hoed the other not, the horſe-hoed part will double the other in product."

Mr Anderdon, in the courſe of his reply to the committee, gives an account of another experiment he made in conſequence of being deficient in winter fodder for his cattle. By this neceſſity he was induced to ſow turnips wherever he could; and on the 18th of July drilled a ſingle row between his drilled wheat. On the 20th and 22d of Auguſt he drilled four rows of winter vetches in each interval between the turnips, at the rate of leſs than one peck and three quarters of ſeed to an acre. "The turnip crop (ſays he) is very acceptable, and my vetches ſucceed beyond my warmeſt expectation; are thick enough, and give me the pleaſing proſpect and hope, that I ſhall not, when my dry meat is gone, want a ſeaſonable ſupply of early green fodder that will laſt me till my lucerne comes on."

328 Mr Pavier's opinion.

This ſubject is farther conſidered in the ſame volume by Mr Pavier, who viewed Mr Anderdon's turnips, and gave in a report of them to the committee. He ſuppoſes a crop of beans drilled in ſingle rows at four feet diſtance, and the turnips drilled in the intervals, according to Mr Anderdon's method, there will then be four rows of 17 feet in length to make a ſquare perch; whereas Mr Anderdon's rows were only 15 feet 8 inches in length; and this diſparity in length will make a difference of weight on a perch from 230 to 249 pounds, and on an acre from 16 tons 8 cwt. 2 qrs. 8 lb. Mr Anderdon's produce, to 17 tons 15 cwt. 2 qrs. 24 lb.—Each turnip at this diſtance (*viz.* four feet from row to row, and nine inches in the rows) muſt occupy a ſpace of three ſquare feet; conſequently the greateſt number produced on an acre muſt be 14,520; but if ſown in broad-caſt, twice hoed, and the diſtance on an average 15 inches, each turnip will then occupy little more than one foot and an half, and the number produced on an acre may be about 27,920; an exceſs which may reaſonably be ſuppoſed to overbalance the value of the beans, let us ſuppoſe the crop as great as we can reaſonably do. Thus far the argument ſeems to lie againſt this method of cultivating beans and turnips together: but on the other hand, Mr Pavier conſiders it probable that the expence of drilling and horſe-hoeing the beans, together with drilling the turnips in the manner Mr Anderdon did, muſt be conſiderably leſs than that of fallowing and preparing the ground, and ſowing the turnips in broad-caſt; to which we muſt likewiſe add the facility of hoeing the drills in compariſon of the broad-caſt. But beſides theſe, the great advantage ariſing from this method, and which, if certain, gives it a decided ſuperiority, is, "the great chance, if not an almoſt certainty, of preſerving the turnips from the depredations of the fly." Mr Pavier was inclined to think that this muſt be the caſe, as Mr Anderdon had ſuch crops repeatedly without any damage of that kind: but the committee differ from him, and think that this muſt have proceeded from ſome other cauſe; though they do not aſſign any reaſon for this opinion. "The principal point (ſays Mr Pavier), in determining this queſtion, ſeems to me to be this: if the crop of beans drilled as above after deducting the ſeed, and ſome additional expence in taking the crop off the ground without injuring the turnips, can be, one year with another, ſuppoſed to be as valuable as the quantity of turnips that might be reaſonably expected in the broad-caſt method more than in the other, I ſhould not heſitate to declare in favour of drilling between the beans."

Thus far the argument ſeems to be carried on *à priori.* Mr Wimpey, in the letter already quoted, inclines to the practice of ſowing turnips between beans planted in rows. "It exactly correſponds (ſays he) with all my obſervations on the ſucceſsful vegetation of that root. A conſiderable degree of moiſture is neceſſary to the rapid vegetation of that very juicy root, and nothing retains moiſture equal to ſhade: and ſhade can be obtained and ſecured by no means ſo effectually on a large ſcale as in the intervals of tall growing plants, as beans or wheat planted in drills." The ſucceſs of Mr Bult of Kingſton near Taunton, leaves little room to doubt of the propriety of the method, and its ſucceſs in preventing the fly. The beans were planted in drills not quite two feet aſunder, on two ploughings, horſe-hoed three times, and the turnips ſown in the intervals at the laſt-hoeing. The field meaſured ſix acres and a quarter, and was a very good clayey ſoil, but had not been manured, nor had any dreſſing laid upon it for ſix years before. It produced this year three quarters of beans per acre, and 37 tons 5 cwt. of turnips. This field was alſo viewed by Mr Pavier, who makes the following obſervations upon it. 1. The turnips were ſown promiſcuouſly among the beans at the laſt hoeing, which was given about midſummer; from which time nothing was done but drawing off the beans and carrying them off the land. 2. The crop of beans was believed to be conſiderably above 20 buſhels per acre, which is much more than was produced by any other method that ſeaſon in the neighbouring part of the country: and as Mr Pavier had this account before he ſaw the turnip crop, he did not expect any thing conſiderable from the latter; but as it turned out, the produce muſt be accounted highly profitable, when we conſider that there was no crop loſt, no preparation, dreſſing, nor any expence whatever, excepting the price of the ſeed and ſowing it. 3. This he conſiders as one of the ſtrongeſt recommendations of the drill huſbandry he ever knew or heard of; but he is of opinion that it never can anſwer except where the ground is perfectly clean and free from weeds, by the crops having been horſe-hoed for a few years before. 4. He thinks the beans ought to have been planted at wider intervals, by which the ſun and air would be freely admitted, and the plants would alſo be leſs damaged by the operation of the hoe.

329 Other experiments on ſowing turnips among beans.

Mr Pavier likewiſe informs the Society of two other experiments on a ſimilar plan; but with this difference, that the turnips were ſown among the beans at the ſecond horſe-hoeing. The turnip crops were very good, and the beans more than *double* the value of thoſe raiſed in the uſual mode of huſbandry. "I think it is very evident (ſays he), that the beans preſerve the turnips from the fly; and as no expence or trouble attends the

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the practice, I apprehend it will soon become more general." The Society own, that the uncommon success of Mr Bult's experiment *seems to militate* at least against what they said on Mr Anderdon's letter; but they insist that the cases are by no means similar. "Though the land (say they), in both instances, is called a *heavy clay*, they are very different. Mr Anderdon's is poor, wet, and cold; the other a good rich clay; and we apprehend naturally mixed with a kind of marl, which is called clay by persons not thoroughly acquainted with the nice distinction of soils apparently alike, but very different in their nature. Our principle therefore, that cold wet clay lands are unsuitable for turnips, remains unaffected by this experiment; and general practice confirms the truth of the theory."

In another letter, Mr Pavier gives a more particular account of the two other crops of beans and turnips raised upon Mr Bult's plan. The beans were drilled in rows about 22 inches distance, twice horse-hoed, and the produce from about 25 to 30 bushels the computed acre, or from 30 to 36 bushels the statute acre. The preceding summer had been very unfavourable to beans, and the produce per acre in the common husbandry did not, on an average, equal a third part of this quantity. One of these crops was superior to that of Mr Bult: they were sown upon a field of nine computed acres on the 10th of June, after the second horse-hoeing; but whether the second hoeing was performed too soon, the ground not clean, or whatever might be the cause, the beans were weeded twice by hand afterwards; and he is of opinion, that the turnips were somewhat benefited by it. Mr Pavier was assured by a very intelligent farmer, that this was the best crop of turnips he had ever seen. The turnip-seed in the other crop was put in between the rows of beans by a hand drill; but the work was badly performed, the plants coming up in some places vastly too thick, and in others as much too thin; but wherever they happened to be of a proper thickness, the farmer told him it was one of the most profitable crops he ever had. The soil was wet, heavy, and not very favourable for turnips. Hence Mr Pavier deduces the following conclusions: 1. That with respect to beans in particular, the drilling and horse-hoeing is vastly superior to the common mode of husbandry. 2. That the beans are undoubtedly a good preservative of the turnips from the depredations of the fly. 3. That as by this method no crop is lost, and consequently no rent, but a mere trifle of expence (if any) chargeable to the turnip crop, it must be one of the most profitable as well as the most certain methods of propagating that useful root ever yet practised.—He still insists, however, that if he had an opportunity of trying this method, he would drill the beans in rows at a greater distance, that the turnips might be hand-hoed easily; and that he should prefer the London tick-bean to any other, by reason of their shortness and being such bearers; that he should also take off their tops as soon as the under blossoms began to decay; which, he supposes, would be of great service.

330 Instrument for transplanting turnips.

In this dissertation on the culture of turuips, we cannot avoid taking notice of an instrument used in Norfolk for transplanting them, and thus filling up the gaps which frequently happen in fields from the failure of the plants in particular spots. It is represented on the margin; and the construction and mode of using are obvious from the figure.—When the turnips are to be transplanted, the workman holds the long handle with the left hand, and the short one with the right hand drawn up. Put the instrument then over the plant that is to be taken up, and with your foot force it into the ground; then give it a twist round, and by drawing it gently up, the earth will adhere to the roots of the plant in a solid body; then with another instrument of the same size take the earth out where the plant is to be put, and bringing the instrument with the plant in it, put it into the hole which has been made by the other; then keep your right hand steady, and draw up your left, and the earth and plant will be left in the hole with the roots undisturbed. In this operation two men must be employed, each of them having an instrument of the form represented on the margin. One man takes up a plant while the other fills his instrument with earth only, thereby making room for the deposition of the plant; so that the hole which is made by taking up the plant is filled with the earth taken out where the plant is to be put; which being deposited, he takes up a plant, and returns to the place he first set out from, the former man at the same time returning with the earth only; so that each man is alternately the planter, and each being employed both ways, the work goes on briskly.—This instrument was the invention of Mr Cubitt Gray of Southrepps, Norfolk.

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Bath Papers, vol. iv. p. 126.

Turnips being the grand basis of the Norfolk husbandry, Mr Marshall gives a very particular account of their culture in that county.—The species cultivated are, 1. The common *white stock*, called in many places the Norfolk turnip. 2. The *purple stock* is similar to the former, but its rind is of a dark red or purple colour; its size in general smaller, and its texture closer and firmer than that of the common white-stock; it also stands the winter better, and is more succulent in the spring, but it is not so well relished by cattle as the former; whence it is less generally cultivated. 3. The *pudding-stock*, the *tankard-turnip* of the midland counties, is in shape so perfectly different from the common sort, that it might be ranked as a distinct species. It rises in a cylindrical form, eight, ten, or twelve inches high, standing in a manner wholly above ground; generally taking a rough irregular outline, and a somewhat reclining posture. It very much resembles the common turnip, and is by much its most formidable rival. In many respects it seems to be superior, particularly in being readily drawn, and eaten off by sheep with much less waste than the common turnip.—The disadvantage is, that they are liable to the attacks of frost, by reason of their standing so high above the surface of the ground; so that on the whole, Mr Marshal concludes, that the common white turnip is to be preferred to every other.

331 Norfolk cultivation of turnips.

332 Advantage of using marl.

In Norfolk, turnips are sown upon every species of arable land. Marl is found to be highly beneficial; and by means of this manure, a soil naturally unfit for turnips may be rendered proper for it. They succeed barley better than any other crop; some few are sown on wheat or pea stubble after harvest; but this is not a general practice. The manures in greatest reputation for turnips are dung, with a greater or smaller admixture

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admixture of mould; *malt-coombs* are alſo in good repute, and oil-cake is uſed by a few individuals; "but it may be ſaid that nine acres of ten of the turnips grown in eaſt Norfolk are manured with muck."—The

333 Manures of different kinds.

quantity of dung ſet on for a crop of turnips generally depends on the quantity on hand, and the quantity of turnip ground to be manured. From 10 to 15 cart loads of muck are conſidered as a good dreſſing; and about a ton of oil cake to three acres; 50 or 60 buſhels of malt-coombs, and 40 or 50 buſhels of ſoot, to an acre.

334 Cultivation of turnips for early conſumption.

When the turnips are intended for early conſumption, the ſooner they can be got into the ground the better; but when they are intended to ſtand the winter, the beginning of July is thought ſoon enough. The moſt general rule is to begin ſowing about a week before midſummer, and continue till about a fortnight after, viz. from the 17th or 18th of June to the

335 Method of ſowing, and culture.

7th or 8th of July.—Broad-caſt ſowing is univerſal, in the quantity of two pints to an acre. The ſeed is covered by two lines of a pair of light harrows drawn backward, in order to prevent the lines, which uſually point ſomething forward, from tearing up the clods, and burying the ſeed too deep. The horſes are univerſally *walked* one way, and *trotted* back again in the ſame place. This is an excellent cuſtom; the quick zig-zag motion of the harrows at once aſſiſting to level the ſurface, and to diſtribute the ſeeds more evenly.—They are univerſally hoed; and unleſs they be ſown very late, are generally hoed twice. The diſtance of time between the ſowing and the firſt hoeing depends upon the ſoil and ſeaſon; the ſize of the plants being the only guide. When turnips are ſuffered to grow too large before they are hoed, the plants are difficult to be ſet out ſingly, and are liable to be drawn up by weeds, thereby acquiring a ſlender upright tendency; whereas their natural growth, in their infant ſtate, is procumbent, ſpreading their firſt leaves on the ground, and taking the form of a roſe.—If the hoe be put in too ſoon, the plants which are ſet out are liable to be buried, and their tender roots diſturbed in the act of ſetting out the neighbouring plants. The time for hoeing, as directed by the moſt judicious huſbandmen, is when the plants, as they lie ſpread upon the ground, are about the ſize of the palm of the hand: if, however, ſeed-weeds be numerous and luxuriant, they ought to be checked before the turnips arrive at that ſize, leſt by being drawn up tall and ſlender they ſhould acquire a weak and ſickly habit. The proper diſtance depends upon the nature of the ſoil and the time of ſowing; ſuch as are ſown early, in a rich productive ſoil, require to be ſet out wider than theſe ſown late on a ſoil of a contrary nature. If the ſoil be at par, the diſtance ought to be regulated by the time of ſowing: if this be at par, the nature or ſtate of the ſoil ſhould be the regulator.—Mr Marſhal complains of the conduct of the Norfolk farmers in general in this reſpect, who "hack out their turnips 14, 15, or perhaps 18 inches aſunder, without any regard to the ſtate of the ſoil, or time of ſowing. This practice was eſtabliſhed while the Norfolk ſoil was full of marl, and new to turnips; and when, it is probable, 11 or 12 inches in diameter was no uncommon ſize, with tops proportionally large and ſpreading; and 14 or 15 inches might then be a proper diſtance. But now, when the efficacy of marl is leſſened, and the ſoil no longer the favourite of turnips, which ſeldom reach more than ſeven or eight inches in diameter, it is ruinous and abſurd to continue the practice."

Turnips are cultivated either for ſeed, for ſale, or for conſumption. When cultivated for ſeed, it is ſuppoſed in moſt parts of the kingdom that it ought always to be taken from tranſplanted roots; but in Norfolk they are frequently raiſed from ſuch as are untranſ- 336

planted. "It is a fact (ſays Mr Marſhall) well un- Cultivation of turnips for ſeed.

derſtood by every huſbandman here, that if the ſeed be gathered repeatedly from untranſplanted roots, the plants from this ſeed will become coarſe-necked and foul-rooted; and the fleſh of the root itſelf will become rigid and unpalatable. On the contrary, if it be gathered year after year from tranſplanted roots, the necks will become too fine, and the fibres too few; the entire plant acquiring a weak delicate habit, and the produce, though ſweet, will be ſmall. For the neck, or onſet of the leaves, being reduced to the ſize of the finger (for inſtance), the number and ſize of the leaves will be reduced in proportion; and in a ſimilar proportion will the number and ſize of the fibrils be reduced. From a parity of reaſoning, it may perhaps be inferred, that when the neck acquires a thickneſs equal to that of the wriſt, the ſize of the root will be in proportion.

"With reſpect to the fibres or rootlings, this is a juſt inference; but with reſpect to the bulb, it is in a great meaſure erroneous. For a few generations the ſize of the bulb will keep pace with the increaſe of leaves and fibres; but after having once reached the limits which nature has ſet to its magnitude, it begins to revert to its original ſtate of wildneſs, from which to it preſent ſtate it has undoubtedly been raiſed by tranſplantation. The farmer has therefore two extremes to avoid. The one is diſcoverable by the thickneſs and coarſeneſs of the neck, the ſcaly roughneſs of the bulb, the thickneſs of the rind in general, the foulneſs of its bottom, and the forkedneſs of its main or tap-root: the other by the ſlenderneſs of the neck, the fineneſs of the leaf, and the delicacy of the root. The former are unpalatable to cattle, and are therefore creative of waſte: The latter are unproductive, are difficult to be drawn, and do not throw out ſuch ample tops in the ſpring, as do thoſe which are, by conſtitution or habit, in a middle ſtate between theſe two extremes. There is not, however, any general rule reſpecting how many years turnips ought to be tranſplanted ſucceſſively, and how often they ought to be ſuffered to run up from the ſeed-bed: the ſoil and ſituation have, and other circumſtances may have, influence on the habit and conſtitution of vegetables as of animals; and the farmer muſt attend alone to the ſtate of the turnips themſelves. Whenever he judges, that, by repeated tranſplantation, they have paſſed the acme of perfection, then it is his duty and intereſt to let them run up to ſeed without tranſplantation. In Norfolk it has been found, by long experience, that tranſplanting two, three, or four years, and letting the plants run up the third, fourth, or fifth, will keep the ſtock in the deſired ſtate. The time of tranſplanting is from Old Chriſtmas to Old Candlemas. In the choice of plants, the farmer is not guided by ſize, but picks the cleaneſt plants without regard to ſize; or, more

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more accurately ſpeaking, he makes choice of ſuch as are near, but not at or above the ſtate of perfection. In almoſt every turnip-field there are plants in various ſtates: much judgment, therefore, is re-

337 Method of planting.

quiſite in the choice of plants. A piece of good ground near a habitation is generally choſen for this purpoſe; but the method of planting is various: the plants are generally ſet in rows, at uncertain diſtances from one another." Theſe diſtances our author has obſerved to be 16 or 18 inches, and the diſtance of the plants in them nine or ten inches; but the practice of a man who, he tells us, is indiſputably near the head of his profeſſion, is to plant them in rows two feet aſunder, the plants in the rows being contiguous. The only culture required, is to keep the intervals clean hoed; but when the ſeed begins to ripen, much care is requiſite to keep it from birds. If the plot be large, it is neceſſary to employ a boy to ſcare them; but if it be ſmall, and near the houſe, Mr Marſhall has known

338 Method of ſcaring away birds.

the following expedient uſed with ſucceſs. "On a ſlender poſt, riſing in the midſt of the patch of ſeed, was fixed a bell; from which a line paſſed into the kitchen; in the moſt frequented part of this hung the pull. Whoever paſſed the pull rung the bell; ſo that in a farm-houſe kitchen, where a miſtreſs and two or three maids were ſome of them almoſt always on the foot, an inceſſant peal was kept up; and the birds, having no reſpite from alarm, forſook their prey."

339 Of drawing the turnips.

The time of drawing commences about Michaelmas, and continues until the plants be in blow. The proceſs of drawing, he ſays, "in ſevere weather is an employment which nothing but cuſtom could reconcile to thoſe whoſe lot it is to go through it, namely, ſtout lads and youths; whoſe hands are frequently ſwelled until the joints are diſcernible only by the dimples they form;" nevertheleſs he never heard of any inſtance of bad effects from this circumſtance. When the tops will bear it, their method of pulling is very expeditious: they pull with both hands at once; and having filled each hand, they bring the two together with a ſmart blow to diſengage the ſoil from the roots, and with the ſame motion throw them into the cart. If the tops be cut off by the froſt, or if this be in the ground, the turnips are raiſed with two-tined forks named

340 Snow-ſledge deſcribed.

crooms. If the roots are buried under deep ſnow, it is removed by means of an implement called the *ſnow-ſledge*. This conſiſts of three deal-boards from one to two inches thick, 10 or 12 inches deep, and from ſeven to nine feet long, ſet upon their edges in the form of an equilateral triangle, and ſtrongly united with nails or ſtraps of iron at the angles; at one of which is faſtened, by means of a double ſtrap, a hook or an eye, to faſten the horſes to. This being drawn over a piece of turnips covered with ſnow, forces up the latter into a ridge on each ſide, while between the ridges a ſtripe of turnips is left bare, without having received any material injury from the operation. Though it is cuſtomary, in drawing, to clear the ground entirely, our author met with one inſtance in which the ſmall ones were left by a very good huſbandman on the ground, both to increaſe in ſize, and to throw out tops in the ſpring; it being obſervable, that a ſmall turnip ſends up a top nearly equal to one whoſe bulb is larger. There is one inconvenience, however, ariſing from this practice: the plough is prevented from entering upon the ſoil until late in the ſpring; which upon ſome ſoils is an unſurmountable objection; tho' is may be very proper upon land which will bring good barley with one ploughing after turnips.

341 Method of preſerving turnips.

Mr Marſhall relates the following ſimple method, by which a Norfolk farmer preſerved turnips through a conſiderable part of the winter ſeaſon. Having cut off their tops with a ſpade, he gave them to his cows, and carried the bulbs to a new-made ditch, into which he threw them, and then covered them up with ſtraw, laying over it a quantity of bramble kids. Here they lay until wanted in a froſt. They were then again carted by means of a fork, and given to the cattle, who ate them as well, or rather better than freſh drawn turnips; and in general they came out as freſh as they went in. Our author is of opinion, that this method might be extended to the preſervation of turnips till the ſpring.

3. Carrot.

342 Culture of carrot.

Of all roots, a carrot requires the deepeſt ſoil. It ought at leaſt to be a foot deep, all equally good from top to bottom. If ſuch a ſoil be not in the farm, it may be made artificially by trench-ploughing, which brings to the ſurface what never had any communication with the ſun or air. When this new ſoil is ſufficiently improved by a crop or two with dung, it is fit for bearing carrots. Beware of dunging the year when the carrots are ſown; for with freſh dung they ſeldom eſcape rotten ſcabs.

The only ſoils proper for that root are a loam and a ſandy ſoil.

The ground muſt be prepared by the deepeſt furrow that can be taken, the ſooner after harveſt the better; immediately upon the back of which, a ribbing ought to ſucceed, as directed for barley. At the end of March, or beginning of April, which is the time of ſowing the ſeed, the ground muſt be ſmoothed with a brake. Sow the ſeed in drills, with intervals of a foot for hand-hoeing: which is no expenſive operation where the crop is confined to an acre or two: but if the quantity of ground be greater, the intervals ought to be three feet, in order for horſe-hoeing.

In flat ground without ridges, it may be proper to make parallel furrows with the plough, ten feet from each other, in order to carry off any redundant moiſture.

At Parlington in Yorkſhire, from the end of September to the firſt of May, 20 work horſes, four bullocks, and ſix milk cows, were fed on the carrots that grew on three acres; and theſe animals never taſted any other food but a little hay. The milk was excellent: and, over and above, 30 hogs were fattened upon what was left by the other beaſts. We have this fact from undoubted authority.

Carrots have been greatly recommended as food for cattle, and, in this reſpect, bid fair to rival the potato; though, with regard to the human ſpecies, they are far inferior. The profit attending the cultivation of them, however, appears to be much more doubtful than that of potatoes. Mr Arthur Young informs us, that from *Norden's Surveyor's Dialogue*, publiſhed in 1600, it appears, that carrots were commonly cultivated at that time about Orford in Suffolk, and Norwich in Norfolk;

Bath Papers, vol. ii. p. 1.

folk; and he remarks, that the tract of land between Orford, Woodbridge, and Saxmundum, has probably more carrots in it than all the reſt of the kingdom put together." In 1779, few farmers in theſe parts had

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Much cultivated in Suffolk and part of Norfolk.

leſs than five or ſix acres; many from 10 to 20; and one had 36 acres: the ſtraight, handſome, and clean roots were ſent at 6d. per buſhel to London; the reſt being uſed at home, principally as food for horſes. In other

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Why the culture has not extended itſelf.

counties, he obſerves, the culture of carrots has not extended itſelf; that ſome have begun to cultivate them in place of turnips, but have ſoon deſiſted; ſo that the culture ſeems in a manner ſtill confined to the angle of Suffolk, where it firſt began. In attempting to inveſtigate the cauſe of this general neglect, he obſerves, that "the charge of cultivation is not ſo great as is commonly imagined, when managed with an eye to an extenſive culture, and not a confined one for one or two particular objects." Two acres which our author had in carrots coſt 3l. 17s. 6d. per acre, including every expence; but had not the ſummer been dry, he obſerves, that his expences might have been much higher; and when he tried the experiment 15 years before, his expences, through inadvertence, ran much higher. His difficulty this year aroſe chiefly from the *polygonum aviculare*, the predominant weed, which is ſo tough that ſcarcely any hoe can cut it. Some acres of turnips which he cultivated along with the carrots were all eaten by the fly; but had they ſucceeded, the expence of the crop would have been 18s. 5d. leſs per acre than the carrots. "But (adds our author) if we call the ſuperiority of expence 20s. an acre, I believe we ſhall be very near the truth: and it muſt at once be apparent that the expence of 20s. per acre cannot be the cauſe of the culture ſpreading ſo little; for, to anſwer

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Superiority of carrots to turnips.

this expence, there are favourable circumſtances, which muſt not be forgotten. 1. They (the carrots) are much more impenetrable to froſt, which frequently deſtroys turnips. 2. They are not ſubject to the diſtempers and accidents which frequently affect turnips; and they are ſown at a ſeaſon when they cannot be affected by drought, which frequently alſo deſtroys turnips. 3. They laſt to April, when ſtock, and eſpecially ſheep farmers are ſo diſtreſſed, that they know not what reſource to provide. 4. The culture requiſite for turnips on a ſandy ſoil, in order to deſtroy the weeds, deſtroys alſo its tenacity, ſo that the crop cannot thrive; but with carrots the caſe is otherwiſe. Hence it appears, that the reaſon why the cultivation of carrots is ſtill ſo

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Difficulty of aſcertaining the value.

limited, does not ariſe from the expence, but becauſe the value is not aſcertained. In places where theſe roots can be ſent to London, or ſold at a good price, the tops being uſed as food for cattle, there is not the leaſt doubt that they are profitable; and therefore in ſuch places they are generally cultivated: but from the experiments as yet laid before the public, a ſatisfactory deciſive knowledge of the value is not to be gained. The moſt conſiderable practice, and the only one of common farmers upon a large ſcale, is that of the ſands of Woodbridge; but here they have the benefit of a London market, as already mentioned. Amongſt thoſe whoſe experiments are publiſhed, Mr Billingſley ranks foremoſt. Here again the value of carrots is rather depreciated than advanced; for he raiſed great crops, and had repeated experience upon a large ſcale of their excellence in fattening oxen and ſheep; feeding cows, horſes, and hogs; and keeping ewes and lambs in a very ſuperior manner, late in the ſpring, after turnips were gone: but notwithſtanding theſe great advantages, he gave the culture up; from which we may conclude a deficiency in value. "In ſeveral experiments (though not altogether determinate), I found the value, upon an average of all applications, to be 13d. a buſhel, heaped meaſure; eſtimating which at 70lb. weight, the ton is 1l. 14s." The following are the valuations of ſeveral gentlemen of the value of carrots in the way of fattening cattle:

	per ton.		
Mr Melliſh of Blyth, a general valuation of horſes, cows, and hogs, -	L. 1	0	0
Mr Stovin of Doncaſter, hogs bought lean, fatted, and ſold off, - -	4	0	0
Mr Moody of Ratford, oxen fatted, and the account accurate, - -	1	0	0
Mr Taylor of Bifrons, ſaving of hay and corn in feeding horſes, - -	1	0	0
Mr Le Grand of Aſh, fattening wethers,	0	13	9
Sir John Hobby Mill of Biſham, fattening hogs, - - -	1	6	0
Mr Billingſley, for fattening hogs, -	1	13	6

Some other gentlemen whom our author conſulted, could not make their carrots worth any thing: ſo that, on the whole, it appears a matter of the utmoſt doubt, ſo contradictory are the accounts, whether the culture of carrots be really attended with any profit or not. Thus Sir John Mill, by fattening hogs, makes 1l. 6s. and Mr Stovin 4l.; but others could not fatten hogs upon them at all: and ſome of Mr Young's neighbours told him, that carrots were good for nothing except to *ſcour* hogs to death. The experiment of Mr Le Grand upon wethers appeared to be made with the greateſt accuracy; yet two circumſtances ſeem to militate againſt it. 1. The ſheep were put lean to them; whereas it is a fact well known, that if they are not half fat when put to turnips, no profit will reſult; and it is poſſible that the caſe may be the ſame with carrots. 2. He gave them alſo as much fine hay as they would eat.

In this uncertain ſtate of the matter, the only thing that can be done is to make a number of experiments with as much accuracy as poſſible, in order to aſcertain the real value per ton: and our author endeavours to ſhow, that there is no danger of loſing much by experiments of this kind. "I have ſhown (ſays he), that 347

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New experiments recommended.

they are to be cultivated for 4l. per acre, left on the ground for ſheep. Suppoſe the crop only two buſhels at 70lb. each per rood, 320 per acre, or ten tons; it will readily be agreed, that ſuch a produce is very low to calculate upon, ſince 20 tons are common among carrot-cultivators. It appears from Mr Le Grand's experiments, that a wether worth 2l. 5s. eats 16lb. of carrots, and four pounds of hay per day: dropping the hay, and calculating for ſheep of leſs than half that ſize (which are much more common), it will be perhaps an ample allowance to aſſign them 12lb. of carrots a day. If they are, as they ought to be, half fat when put up, they will be completely fattened in 100 days. At this rate, 20 wethers will, in 100 days, eat 11 tons, or very little more than one moderate acre. Now, let it be remembered, that it is a good acre of turnips which will fatten eight ſuch wethers, the common Norfolk calculation;

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calculation: from which it appears, that one acre of carrots is, for this purpoſe, of more value than two of turnips. Further, let us ſuppoſe horſes fed with them inſtead of oats: to top, cart, and pack up, 10 tons of carrots, I know may be done for 20s.—An acre therefore (other expences included) coſts 5l. Fifty pounds weight of carrots are an ample allowance for a horſe a day: ten tons, at that rate, laſt three horſes for five months. But this 5l. laid out in oats at 16s. per quarter, will purchaſe little more than ſix quarters; which will laſt three horſes, at two buſhels each per week, no more than two months; a moſt enormous inferiority to the carrots."

348 Experiment on feeding lambs with them.

In the ſame volume, p. 187. Mr Young gives an account of another experiment made by himſelf on the feeding of lambs with carrots. The quantities they eat varied exceſſively at different times; thirty-ſix of them conſumed from five to ten buſhels per day; but on an average, he rates them at four buſhels of 56 pounds per day. In all, they conſumed 407 buſhels from November to April, when they were ſold and killed fat. At putting upon the carrots, the lambs were valued only at 18l. but were ſold in April at 25l. 4s.; ſo that the value of the carrots was exactly 7l. 4s. or about 4d. per buſhel. This price he ſuppoſes to be ſufficient to induce any one to attempt the culture of carrots, as thus he would have a clear profit of 40s. *per* acre; "which (ſays he) is greater than can attend the beſt wheat crops in this kingdom." The land on which the carrots grew was ſown next year with barley, and produced the cleaneſt in the pariſh; which contradicts an aſſertion our author had heard, that carrots make land foul. The graſs upon which the ſheep were fed with the carrots, and which amounted to about an acre, was very little improved for the crop of hay in 1781, owing to the dryneſs of the ſeaſon; but in 1782 was greatly ſuperior to the reſt of the field, and more improved in quantity: "for, inſtead of an indifferent vegetation, ſcattered thick with the centaurea ſcabioſa, filago, rhinanthus, criſta galli, and linum catharticum, with other plants of little value, it encouraged a very beautiful ſheet of the beſt plants that can appear in a meadow, viz. the lathyrus pratenſis, achillea millefolium, trifolium repens, trifolium ochroleucrum, trifolium alpeſtie, and the plantago lanceolata.

349 Carrots compared with cabbages.

In the ſame volume of the Bath papers, p. 227, Mr Billingſley gives an account of the comparative profit of carrots and cabbages. Of the former, however, he obtained only ſeven tons, 15 cwt. *per* acre; the cabbages produced 36 tons: nevertheleſs, according to him, the profit of the former was 5l. 8s.; of the latter, only 3l. 11s. In a paper on the culture of carrots by Mr Kirby of Ipſwich, vol. iii. p. 84. he informs us, that he never determined the weight of an acre, but reckons the produce from 200 to 500 buſhels; which, at 56lb. to the buſhel, is from five to ten tons and an half.

350 Culture of carrots preferred to potatoes.

In the ſame volume, p. 320, the Rev. Mr Onley ſeems to prefer the culture of carrots to potatoes. "However valuable (ſays he), from eaſe of culture, and greatneſs of produce to the poor, eſpecially in all ſmall ſpots, I doubt, unleſs near great towns, whether on a farming plan, potatoes be ſo eligible as other herbage or roots, eſpecially as carrots, which I cannot but *ſurmiſe* (for my trials are too trivial to venture bolder language), deſerve every encouragement, even on ſoils hitherto thought too heavy for them.—I am from experience convinced, that an acre of carrots will double in the quantum, of equally hearty provender, the product of an acre of oats; and from the nature of their vegetation, the nice mode of cultivation, and even of taking them up (all of which, expenſive as they are, bear a very inferior proportion to the value of a medium crop), muſt leave the land, eſpecially if taken off it in an early period, ſo mellow for the plough, as to form a ſeed-bed for barley equal to any fallow-tilth."

Mr Onley's deſideratum was a ſubſtitute for oats to feed horſes; of which great numbers are kept in his county (Eſſex). Potatoes, he obſerves, are excellent for *ſmall* pork, when baked or boiled, mixed with a little barley meal; but for large hogs, they are moſt profitably given raw, if theſe have at the ſame time the ſhack of the barn door in threſhing ſeaſon, &c. In the 5th volume he reſumes the ſubject, and acquaints us, that he applied a ſingle acre in his bean field to the culture of carrots, which generally produced 400 buſhels; and this he conſiders as a ſmall produce. "I am, however, ſenſible (ſays he) that they will amply repay every expence of the fineſt culture; and ſhould, from their extenſive utility on ſound, deep, and friable land, be everywhere attempted. Some of my neighbours, who have been induced to try them on rather a larger ſcale, with finer culture, and freſher ſoil, have raiſed from 600 to 900 buſhels *per* acre, and applied them more profitably, as well as more generally, than any other winter herbage, to deer, ſheep, bullocks, cows, and horſes. At the loweſt calculation, from our little trials, they are computed to exceed turnips in value one-third, as to quantity of food; but are far ſuperior in what ariſes from convenience for the ſtable; where to us they ſeem to be a ſubſtitute for corn to all horſes, at leaſt ſuch as are not uſed in any quick work; and partially ſo with corn for thoſe that are." 351

351 Superior to turnips and oats.

In making a compariſon betwixt the profit on oats and carrots, Mr Onley found the latter exceed by no leſs than 2l. 15s. 8d. *per* acre. His method of cultivation is to ſow them in March or April; to hoe them three times, harrowing after each hoeing. Sometimes he left them in the ground till after Chriſtmas, taking them up as wanted; but afterwards he took them up in October, in dry days, putting them directly into ſmall upright cocks of 10 buſhels each, covered entirely, with the tops cut off.—Thus they appear to dry better than in any other way, and bear the weather with very little loſs. If, after being thus dried, they are carried into any barn or ſhed, it will be better, if they are in large quantities, not to pack them cloſe, on account of the danger of heating, but rather to throw them promiſcuouſly into heaps, with a little ſtraw over them. When perfectly dry, they do not in general require any waſhing, except for horſes regularly kept in the ſtable.

This root has been found ſo generally valuable as a ſubſtitute for grain in feeding horſes, that its uſe in that way is rapidly ſpreading into various parts of the country. By the quantity of ſaccharine matter which it contains, it is probably rendered extremely rich and ſtimulating to the ſtomach of that delicate animal, ſo that a leſs quantity of it goes to waſte than of any other food. We may remark that the gentleman already mentioned, Mr Onley, who had the merit of preſſing

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preſſing upon the public attention the importance and utility of this root, mentions an uſe to which we believe it is not unfrequently applied in the dairy. "In our dairies (ſays he) as many carrots are bruiſed before churning, as produce, ſqueezed through a cloth into as much cream as makes eight or ten pound of butter, an half pint of juice; this adds ſomewhat to the colour, richneſs, and flavour of winter butter; and we think, where hay is allowed beſides, contributes much to counteracting the flavour from the ſeed of turnips. At preſent (our carrot ſeed being exhauſted) from turnips and hay, with this juice, our butter is equal to that of the Epping dairies."

* *Annals of Agriculture*, vol. xii.

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Carrots uſed to colour butter.

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Carrots advantageouſly cultivated in young plantations.

We may conclude by taking notice here of an advantageous mode of cultivating carrots by making uſe of them with a view to ſtir the ground in young plantations. It was adopted by Thomas Walford, Eſq. of Birdbrooke, Eſſex, who gives the following account of it:—"It has been my conſtant practice for theſe laſt five years, wherever I made a plantation of firs, or deciduous trees, to ſow the ground in the ſpring with carrots, which I have found not only pay part of my expences, and frequently the whole, but much more beneficial to the trees than any other method I had before adopted.

"When I make a plantation of deciduous trees, the ground is dug two ſpits deep in October, and planted immediately, leaving it in that ſtate until the middle or latter end of March, or beginning of April; then, if neceſſary, chop it over with a hoe, and ſow my carrots; if for firs, I do not dig the ground until March, at which time I plant my trees, and ſow the carrots, having found my crop more luxuriant and productive upon ground freſh dug than that which was dug in the autumn.—I give for digging 8d *per* rod; hoe only twice; the produce is generally four buſhels of clean carrots, which I ſell at 6d. *per* buſhel, the buyer to fetch them from their place of growth.

"The ſoil in ſome places, looſe and hollow; the under ſtratum clay; in others a fine vegetable mould upon a red loam.

"I find in taking up the carrots, leſs damage is done to the young fibres of the trees, than by digging between them; for, it is impoſſible with the greateſt care of your ſervants, not to cut off ſome of them by digging, and thereby injure the trees, beſides leaving the ground in no better ſtate than it is after carrots; for when the carrot is drawn, the cavity is filled immediately with looſe mould, through which the young fibres will ſtrike with great freedom, and very much accelerate the growth of the trees."

4. Parsnips.

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The cultivation of parſnips too much neglected.

Parſnips have never in this country received from huſbandmen that attention to which they are well entitled from the eaſe with which they are cultivated, and the great quantity of ſaccharine or nouriſhing matter they are known to contain, which certainly abounds in them, in a much greater proportion than in almoſt any other vegetable with which we are at preſent acquainted.

Bath Papers, vol. iv. p. 244.

To cultivate this root (ſays Mr Hazard) ſo as to make it advantageous to the farmer, it will be right to ſow the ſeed in the autumn immediately after it is ripe; by which means the plants will appear early the following ſpring, and get ſtrong before the weeds can riſe to injure them. Neither the ſeeds nor young plants are ever materially injured by froſts; on which account, as well as many others, the autumn is preferable to the ſpring ſowing. The beſt ſoil for them is a rich deep loam, and next to this ſand. They will thrive well in a black gritty ſoil, but not in ſtonebraſh, gravel, or clay; and they are always largeſt in the deepeſt earth. If the ſoil be proper, they do not require much manure. Mr Hazard obtained a very good crop for three years upon the ſame piece of ground without uſing any; but when he laid on about 40 cart loads of ſand *per* acre upon a ſtiff loam, and ploughed it in, he found it anſwer very well; whence he concludes, that a mixture of ſoils may be proper for this root. The ſeed may be ſown in drills at about 18 inches diſtance from one another, that the plants may be the more conveniently hand or horſe hoed; and they will be more luxuriant if they undergo a ſecond hoeing, and are carefully earthed, ſo as not to cover the leaves. Such as have not ground to ſpare, or cannot get it in proper condition in autumn, may at that time ſow a plot in their garden, and tranſplant from thence in the latter end of April, or early in the month of May following. The plants muſt be carefully drawn, and the ground well pulverized by harrowing and rolling; after which a furrow ſhould be opened with the plough, about ſix or eight inches deep, in which the plants ſhould be regularly laid at the diſtance of about ten inches from each other, taking care not to let the root be bent, but for the plant to ſtand perpendicular after the earth is cloſed about it, which ought to be done immediately by means of perſons who ſhould for this purpoſe follow the planter with a hoe. Another furrow muſt be opened about 18 inches from the former, in the ſame direction, and planted as before; and ſo on in like manner until all the plants are depoſited, or the field be completely cropped; and when the weeds appear, hoeing will be neceſſary, and it will afterwards be proper to earth them; but if the leaves of the plants be covered with earth, the roots will be injured. Parſnips ought not to be planted by dibbling, as the ground thus becomes ſo bound, as ſeldom to admit the ſmall lateral fibres with which theſe roots abound to fix in the earth, by which they are prevented from expanding themſelves, and never attain a proper ſize. When circumſtances are properly attended to, there is little doubt that a crop of parſnips would anſwer much better than a crop of carrots. They are equal, if not ſuperior, in fattening pigs, as they make their fleſh whiter, and the animals themſelves are more fond of theſe roots than of carrots. Horſes eat them greedily when clean waſhed and ſliced among bran, and thrive very well upon them; and black cattle are ſaid likewiſe to approve of them.

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Mr Hazard's method of cultivation.

Though parſnips are little uſed in Britain, they are highly eſteemed in France. In Britanny they are thought, as food for cattle, to be little inferior to wheat; and cows fed with them are ſaid to give as much milk, and of as good quality, as in the ſummer months. In the iſland of Jerſey they have long been conſidered as of the higheſt importance; and as the mode of cultivating them there ſeems worthy of attention, we ſhall here give an account of it, from a paper tranſmitted by the

the Agricultural Society of Jersey to the British Board of Agriculture.

356 Culture of parsnips with beans in Jersey and Guernsey.

"It is impossible, say these gentlemen, to trace the period when the cultivation of this plant was first introduced amongst us. It has been known for several centuries, and the inhabitants have reaped such benefit therefrom, that, for fattening their cattle and pigs, they prefer it to all the known roots of both hemispheres. The cattle fed therewith yield a juicy and exquisite meat. The pork and beef of Jersey are inconsestably equal, if not superior, to the best in Europe. We have observed, that the beef in summer is not equal to that in the autumn, winter, and spring periods, when the cattle are fed with parsnips; which we attribute to the excellency of that root.

"All animals eat it with avidity, and in preference to potatoes. We are ignorant of the reason, having never made any analysis of the parsnip. It would be curious, interesting, and useful, to investigate its characteristic principles: it is certain that animals are more fond of it than of any other root, and fatten more quickly. The parsnip possesses, without doubt, more nutritious juices than the potato. It has been proved that the latter contains eleven ounces and a half of water, and one gros of earthy substance, French weight; therefore, there only remain four ounces and five gros of nutritive matter. Probably the parsnip does not contain near so much watery particles; nevertheless, they digest very easily in the animal's body. The cows fed with hay and parsnips during winter yield butter of a fine yellow hue, of a saffron tinge, as excellent as if they had been in the most luxuriant pasture."

These gentlemen proceed to state, that, in the island of Jersey, parsnips are not cultivated alone, but along with beans, among which last pease are sometimes mixed. There are three modes of cultivation: 1st, With the spade; 2d, With the plough and spade; and 3d, With two ploughs, the one called the small and the other the great plough. This last method, as being the most economical and advantageous to the husbandman, is the only one described. In the month of September, a slight ploughing and preparation is sometimes given to the field destined for beans and parsnips in the ensuing year; but more generally the whole work is performed in high grounds about the middle of February, and in the middle of March in low land. A light plough cuts and turns the earth about four or five inches deep; then follows it a large plough constructed on purpose, and only used for this operation, which elevates the earth on the furrow laid open, and turns it over that which the small plough turned up. The essential point is to plough deep and to cover the clods over again.

The field thus prepared, is suffered to remain 15 days, after which it is very lightly harrowed. On the same day, or on the ensuing, the beans are planted in the following manner. Straight lines must be drawn from north to south with a gardeners rake at $4\frac{1}{2}$ feet distance. On these straight lines, 19 inches in breadth, women plant four or five beans in rows 4 inches distant from each other, or the beans are planted in double rows all over the field, at the usual depth, and 12 feet distance from each other, with the beans spaced out 18 inches from each other. When all this is done, the parsnips are sown in broad-cast over the field, after which it is well harrowed. In 15 days after, if the weather has been warm and rainy, or in three weeks if it has been cold and dry, the ground is harrowed again to cut up the weeds. In five or six weeks the beans shoot out, and the ground soon appears as if covered by hedges or laid out in paths for walking; for in the spaces between the lines where the beans were planted are as many alleys, where women and children weed with great facility. They generally weed the ground twice, and the operation is performed with a two-pronged fork, such as is used in gardens. The first weeding is performed at the end of April or beginning of May, when the plants must be cleared out if they are too thick. When the beans are ripe, which is in August or September, they are immediately plucked up, not to incommode the parsnips. The crop of beans is not always certain. If high winds or fogs prevail when they are in flower, the produce will be scanty; but the parsnips in a manner never fail. They neither dread the inclemency of the weather, nor are affected by the hardest frost, nor by any of those accidents which at times will instantly destroy a whole crop.

Parsnips grow till the end of September, but some give them to cattle they wish to fatten in the beginning of September. The people of these islands consider the parsnip as the most juicy and nutritious of all roots known. Its cultivation is an excellent preparation for wheat, which is sown there without manure after parsnips, and yields a plentiful crop. It must be observed, that though this cultivation of parsnips is expensive where the price of labour is high, no dung or manure is necessary either for the parsnips or the wheat. They reckon 30 perches of parsnips, with a little hay, will fatten an ox of three or four years old, though ever so lean; he eats them in the course of three months as follows: they are given at six in the morning, at noon, and at eight at night, in rations of 40lb. each; the largest are slit into three or four pieces; but not washed unless very much covered with earth. In the intermediate hours, at nine in the morning, two in the afternoon, and nine at night, a little hay is given. Experience has shewn, that when cattle, pigs, or poultry, are fed with parsnips, they are sooner fattened and are more bulky than with any other root or vegetable whatever. The meat of such is most delicate and savoury. In spring the markets are furnished with the best and fattest beef from their feeding on parsnips. The crops of parsnips raised in Jersey and Guernsey are very great. On an extent of 1000 feet, the produce of a field of beans and parsnips is about 1200lb. weight of parsnips, Rouen measure, and thirty cabots or half bushels of beans, and three cabots and a half of pease; which altogether, according to the price at which these articles are actually sold there, amount to the sum of 256 livres French currency. The following information was also received from the president of the Jersey Society on 1st March 1796, viz. "Since writing concerning the crop of beans and parsnips together, we have found that an individual who cultivates parsnips without sowing either pease or beans along with them had a crop of 14,760lb. weight Rouen measure per vergee." The vergee is 40 perches in length and one perch in breadth.

III. Plants

III. Plants cultivated for Leaves, or for both Leaves and Root.

1. Turnip-rooted Cabbage.

357 Cultivation of the turnip-rooted cabbage.

This plant may deſervedly be reckoned next in value to the turnip itſelf. Its advantages, according to Sir Thomas Beevor, are, "that it affords food for cattle late in the ſpring, and reſiſts mildew and froſt, which ſometimes deſtroy the common turnip;" whence he is of opinion that every farmer who cultivates the common turnip ſhould always have part of his farm laid out in the cultivation of this root. The importance and value of turnip-rooted cabbages ſeem only to have been lately aſcertained. In the Bath Society papers we have the following account of Sir Thomas Beevor's method of cultivating them; which from experience he found to be cheaper and better than any other.

"In the firſt or ſecond week of June, I ſow the ſame quantity of ſeed, hoe the plants at the ſame ſize, leave them at the ſame diſtance from each other, and treat them in all reſpects like the common turnip. In this method I have always obtained a plentiful crop of

358 Their utility and value.

them; to aſcertain the value of which I need only inform you, that on the 23d day of April laſt, having then two acres left of my crop, ſound, and in great perfection, I divided them by fold hurdles into three parts of nearly equal dimenſions. Into the firſt part I put 24 ſmall bullocks of about 30 ſtone weight each (14lb. to the ſtone), and 30 middle-ſized fat wethers, which, at the end of the firſt week, after they had eaten down the greater part of the leaves, and ſome part of the roots, I ſhifted into the ſecond diviſion, and then put 70 lean ſheep into what was left of the firſt; theſe fed off the remainder of the turnips left by the fat ſtock; and ſo they were ſhifted through the three diviſions, the lean ſtock following the fat as they wanted food, until the whole was conſumed.

"The 24 bullocks and 30 fat wethers continued in the turnips until the 21ſt of May, being exactly four weeks; and the 70 lean ſheep until the 29th, which is one day over four weeks: ſo that the two acres kept me 24 ſmall bullocks and 110 ſheep four weeks (not reckoning the overplus day of keeping the lean ſheep); the value, at the rate of keeping at that ſeaſon, cannot be eſtimated in any common year at leſs than 4d. a-week for each ſheep, and 1s. 6d. per week for each bullock, which would amount together to the ſum of 14l. 10s. 8d. for the two acres.

"You will hardly, I conceive, think I have ſet the price of keeping the ſtock at too high a rate; it is beneath the price here in almoſt every ſpring, and in this laſt it would have coſt double, could it have been procured; which was ſo far from being the caſe, that hundreds of ſheep and lambs here were loſt, and the reſt greatly pinched, for want of food.

"You will obſerve, gentlemen, that in the valuation of the crop above mentioned I have claimed no allowance for the great benefit the farmer receives by being enabled to ſuffer his graſs to get into a forward growth, nor for the ſuperior quality of theſe turnips in fattening his ſtock; both which circumſtances muſt ſtamp a new and a great additional value upon them. But as their continuance on the land may ſeem to be injurious to the ſucceeding crop, and indeed will deprive the farmer totally of either oats or barley; ſo to ſupply that loſs I have always ſown buck-wheat on the firſt earth upon the land from which the turnips were thus fed off; allowing one buſhel of ſeed per acre, for which I commonly receive from five to ſix quarters per acre in return. And that I may not throw that part of my land out of the ſame courſe of tillage with the reſt, I ſow my clover or other graſs ſeeds with the buck-wheat, in the ſame manner as with the oat or barley crops, and have always found as good a *layer* (ley) of it afterwards.

"Thus you ſee, that in providing a moſt incomparable vegetable food for cattle, in that ſeaſon of the year in which the farmer is generally moſt diſtreſſed, and his cattle almoſt ſtarved, a conſiderable profit may likewiſe be obtained, much beyond what is uſually derived from his former practice, by the great produce and price of a crop raiſed at ſo eaſy an expence as that of buck-wheat, which with us ſells commonly at the ſame price as barley, oftentimes more, and but very rarely for leſs.

"The land on which I have uſually ſown turnip-rooted cabbages is a dry mixed ſoil, worth 15s. per acre."

To the preceding account the ſociety have ſubjoined the following note: "Whether we regard the importance of the ſubject, or the clear and practical information which the foregoing letter conveys, it may be conſidered as truly intereſting as any we have ever been favoured with: and therefore it is recommended in the ſtrongeſt manner to farmers in general, that they adopt a mode of practice ſo deciſively aſcertained to be in a high degree judicious and profitable." 359 Recommendation by the Bath Society.

To raiſe the turnip-rooted cabbage for tranſplanting, the beſt method yet diſcovered is, to breaſt-plough and burn as much old paſture as may be judged neceſſary for the ſeed bed; two perches well ſtocked with plants will be ſufficient to plant an acre. The land ſhould be dug as ſhallow as poſſible, turning the aſhes in; and the ſeed ſhould be ſown the beginning of April.

The land intended for the plantation to be cultivated and dunged as for the common turnip. About midſummer (or ſooner if the weather will permit) will be a proper time for planting, which is beſt done in the following manner: the land to be thrown into *one-bout* ridges, upon the tops of which the plants are to be ſet, at about 18 inches diſtance from each other. As ſoon as the weeds riſe, give a hand-hoeing; afterwards run the ploughs in the intervals, and fetch a furrow from each ridge, which, after laying a fortnight or three weeks, is again thrown back to the ridges; if the weeds riſe again, it is neceſſary to give them another hand-hoeing. 360 To raiſe the turnip-rooted cabbage for tranſplanting.

If the young plants in the ſeed-bed ſhould be attacked by the fly, ſow wood-aſhes over them when the dew is on, which will effectually prevent the ravages they would otherwiſe make.

In another letter from Sir Thomas Beevor, Bath Papers, vol. viii. p. 489. he expreſſes his hope that the turnip-rooted cabbages he had would laſt until he ſhould have plenty of graſs for all his ſtock. To make a comparative eſtimation of the quantity of food yielded by the turnip-rooted cabbage and the common turnip, he ſelected ſome of each kind, and having girted them with as much accuracy as poſſible; he found, that 361 Compariſon of the quantity of feed in this and in the common turnip.

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a turnip-rooted cabbage of 18 inches circumference weighed $5\frac{1}{4}$lb. and a common turnip of the same size only $3\frac{1}{2}$lb.; on trying others, the general result was found to be in that proportion. Had they been weighed with the tops, the superiority of the turnip-rooted cabbage would have been greater, the tops of them being remarkably bushy. They were weighed in the month of March; but had this been done at Christmas, our author is of opinion that the difference would not have been so great; though he reckons this very circumstance of their continuing so long to afford a nourishing food, an instance of their excellency above almost every other vegetable whatever.

362 Other experiments.

In the fourth volume of the same work, Sir Thomas gives an account of another experiment on five acres of turnip-rooted cabbage, four of which were eaten upon the field, the other was pulled up and carried to the stables and ox-houses. They were sown and cultivated as other turnips; the beasts were put to them on the 12th of April, and continued feeding upon them till the 11th of May. The cattle fed for this space of time were, 12 Scotch bullocks weighing 40 stone each; eight homebreds, two years old; fifteen cows full-sized; 40 sheep; 18 horses; besides 40 store-hogs and pigs, which lived upon the broken pieces and offal, without any other allowance, for the whole four weeks. The whole value of the plant, exclusive of the feeding of the pigs, amounted, according to our author's calculation, to 18l.; and he says that the farmers would willingly give this sum in the spring for feeding as many cattle: "because it enables them to save the young shooting grass (which is so frequently injured by the tread of the cattle in the frosty nights) until it gets to such a length and thickness as to be afterwards but little affected by the summer's drought. Besides this, the tops or leaves are in the spring much more abundant, and much better food than those of the common turnip, as already observed; and they continue in full perfection after all the common turnips are rotten or worthless.

363 Disadvantages attending the cultivation of this plant.

The disadvantages attending the cultivation of turnip-rooted cabbages are, that they require a great deal of time and pains to take them up out of the ground, if they are to be carried off the field; and if fed where they grow, it requires almost an equal labour to take up the pieces left by the cattle. A great deal of earth is also taken up along with the root; and the substance of the latter is so firm and solid, that they must be cut in two in order to enable the cattle to eat them. To obviate some of these objections, it will be proper to sow the plants on rich and very light land; and as they are longer in coming to the hoe than the common turnip, it will be proper to sow them about the beginning of June.

364 Why every farmer ought to cultivate this plant.

In another experiment upon this plant by the same gentleman, the cabbages held out during the long and severe frost of 1788 without the least injury, though it destroyed three-fourths of all the common turnips in the neighbourhood. On the 21st of April 1789, the average produce of an acre was found to be somewhat more than $24\frac{1}{2}$ tons, though the tops had not sprouted above three inches. Considering the precariousness of turnips and other crops, Sir Thomas is decisively of opinion, that all farmers ought to have as many turnip-rooted cabbages as would afford and ensure them a full provision for their cattle for about three or four weeks during the latter part of the spring. This quantity he reckons sufficient, as the consumption, particularly when drawn and carried off the land, is attended with more trouble and expence than that of common turnips, especially if the soil be wet and heavy. In another letter, dated May 3. 1790, Sir Thomas Beevor once more sets forth the advantages of having a crop of these vegetables during the spring season. "In consequence (says he) of the very cold weather we have had here, the grass is but just springing; as the turnips are wholly eaten up, it occasions much distress among the farmers for want of some green vegetable food for their sheep and cattle; whereas, by the assistance of my turnip-rooted cabbages, I have abundance of the best and most nutritive food that can be found them." He then proceeds to recommend their culture "for the support of almost all live stock for the three last weeks of April, or first week of May, when the grass shoots late."

In the 4th volume of the Transactions of the Society for encouraging Arts, Mr Robins, who received a premium for raising the greatest quantity of this plant, informs us, that the soil on which it grew was a *stone braish*, inclining to sand, not worth more than 10s. per acre; the preparation the same as for turnips. The manure was a compost of earth and dung, which he finds to answer better than dung. The seed was sown about the beginning of April on a clean spot of ground; and he commonly uses an old pasture where the sheep-fold has been in the winter, after taking away the dung, and digging it very shallow; "as the roots of the young plants (says he) might soon reach the dung or salts, which must consequently be left, in order to force them out of the fly's way." These insects, our author observes, are extremely fond of the turnip-rooted cabbage; much more so, he believes, than of common turnips. About the middle of June they should be planted out upon one-bout ridges raised by a double plough made for the purpose. Seven thousand plants are sufficient for one acre; but if only six are used, the roots will be the larger.

To determine how many sheep might be kept upon an acre of turnip-rooted cabbage, our author shut up 200 ewes with their lambs upon a piece of poor pasture land of no great extent; the whole not exceeding ten acres. One ton was found sufficient for keeping them in sufficient health for a day. On giving them a larger piece of ground to run over, though it had been eaten all winter and late in the spring, yet, with this trifling assistance, 13 tons of turnip-cabbage were made to serve 18 days; at the end of which the ewes and lambs were found very much improved, which could not have been expected from four acres of turnips in the month of April, the time that these were fed. 365 Number of sheep fed by an acre of turnip-rooted cabbages.

From some trials made on the turnip-rooted cabbage at Cullen House in the north of Scotland, it appears that the plant is adapted to the climate of every part of our island. The first trial was made in the year 1784. The seeds were sown about the middle of March in garden ground properly prepared. The cabbages were transplanted about the middle of March that year into a dry light soil, well cleaned and dunged with rotten cow-dung, in rows three feet distant from each other, and at the distance of 20 inches in the 366 Experiments at Cullen-house.

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the rows. They were kept very clean, and the earth was hoed up to the roots of the plants; by which means they were probably prevented from attaining the hardneſs they would otherwiſe have arrived at; though, after all, it was neceſſary to cut the roots in two before the ſheep could eat them. When thus cut, the animals ate them greedily, and even preferred them to every other food. The roots continued good for at leaſt a month after the common turnips were unfit for uſe: ſome of them weighed from eight to ten pounds, and a few of them more. Other trials have ſince been made; and it now appears that the plant will thrive very well with the ordinary culture of turnips in the open fields, and in the uſual manner of ſowing broad-caſt. From a comparative trial made by the earl of Fife upon this root with ſome others, the quantities produced upon 100 ſquare yards of ground were as follows:

	ſtone.	lb.
Common turnips -	92	4
Turnip-rooted cabbage -	88	0
Carrots - - -	95	0
Root of ſcarcity - -	77	0

The turnip-rooted cabbage was planted in lines 20 inches aſunder; the common turnips ſown broad-caſt, and hand-weeded, ſo that they came up very thick, being not more than three or four inches aſunder when full grown. Two cows were fed for ſix weeks with the turnips, two with the turnip-rooted cabbage, and two with the root of ſcarcity for an equal time: the two fed with turnips gave moſt milk, and thoſe with the root of ſcarcity the leaſt. His lordſhip obſerves, however, that carrots thrive better on his farm than any other crop: that his horſes had been fed on them at the rate of two pecks a-day, with no corn, and little more than half the uſual quantity of hay. "They were kept at work every day from ſeven to eight hours, and were never in better order."

2. Swedish Turnip, or Roota Baga.

367 Of the roota baga.

The roota baga, or Swediſh turnip, is a plant from which great expectations have been formed. It is ſaid to be hardier than the common turnip, and of greater ſweetneſs and ſolidity. It alſo preſerves its freſhneſs and ſucculence till a very late period of its growth, even after it has produced ſeed; on account of which property it has been recommended to the notice of farmers as an excellent kind of ſucculent food for domeſtic animals in the ſpring of the year, when common turnips and moſt other winter crops have failed, and before graſs has got up to furniſh an abundant bite for feeding beaſts. This peculiarity, ſo valuable, yet ſo ſingular as to have led many at firſt to doubt the fact, ſeems to be ſufficiently aſcertained by experiment. Dr J. Anderſon * in particular informs us, that it "begins to ſend out its flower-ſtems in the ſpring, nearly about the ſame time with the common turnip; but that the root, in conſequence of that change of ſtate, ſuffers very little alteration. I continued to uſe theſe turnips at my table every day till towards the middle of May; and had I never gone into the garden myſelf, I ſhould not even then have ſuſpected, from the taſte or appearance of the bulb itſelf, that it had been ſhot at all. The ſtems, however, at the ſeaſon I gave over uſing them, were from four to five feet high, and in full flower. I ſhould have continued the experiment longer, had not the quantity I had left for that purpoſe been exhauſted, and a few only left for ſeed.

* The *Bee*, vol. iii. p. 291.

"This experiment, however, fully proves, that this kind of turnip may be employed as a ſucculent food for cattle till the middle of May at leaſt, in an ordinary year; and I have not the ſmalleſt doubt but it will continue perfectly good for that purpoſe till the end of May in any ſeaſon; at which time graſs and other ſpring crops can eaſily be had for bringing beaſts forward in fleſh. I can therefore, without heſitation, recommend this plant to the farmer as a moſt valuable ſpring feeding for cattle and ſheep; and for this purpoſe, I think no wiſe farmer ſhould be without a proportion of this kind of turnip to ſucceed the other ſorts after they fail. The profitable method of conſuming it, where it is to be kept very late, is, I am convinced, to cut off the tops with a ſcythe or ſickle when from one foot to eighteen inches high, to induce it to ſend out freſh ſtems, that will continue ſoft and ſucculent to the end; whereas, without this proceſs, the ſtems would become ſticky and uſeleſs.

"I cannot, however, recommend this kind of turnip, from what I have yet ſeen, as a general crop; becauſe I think it probable, that unleſs in particular circumſtances, the common field turnips grow to a much larger ſize, and afford upon the whole a more weighty crop. Theſe, therefore, ſhould ſtill continue to be cultivated for winter uſe, the other being reſerved only for ſpring conſumption.

"Experiments are ſtill wanting to aſcertain with certainty the peculiar ſoil and culture that beſt agree with this plant; but from the few obſervations I have hitherto had an opportunity of making upon it, it ſeems to me probable, that it thrives better, and grows to a larger ſize on damp clayey ſoil, than on light ſandy land. But I would not wiſh to be underſtood as here ſpeaking poſitively; I merely throw it out as a hint for future obſervation: on ſpongy ſoil it proſpers.

"Though the uſes of this as a garden plant are of much ſmaller conſequence than thoſe above ſpecified, it may not be improper to remark, that its leaves form a very ſweet kind of greens at any time; and merely for the ſake of the experiment, I cauſed ſome of theſe to be picked off the ſtems of the plants coming to ſeed, on the 4th of June, the king's birth-day, which, on being readied, were found perfectly ſweet, without the ſmalleſt tendency to bitterneſs, which moſt, if not all, other kinds of greens that have been hitherto cultivated are known to acquire after their ſtems are conſiderably advanced; no family, therefore, can ever be at a loſs for greens when they have any of this plant in ſeed.

"A root of this kind of turnip was taken up this day (June 15.); the ſeed-ſtalks were firm and woody, the pods full formed, and in ſome of them the ſeeds were nearly ripe. The root, however, was as ſoft and ſucculent as at any former period of its growth; nor was the ſkin, as I expected, hard or woody. It was made ready and brought to the table: ſome perſons there thought the taſte as good, if not better, than at any former period of its growth; but I myſelf, perhaps through prejudice, thought it had not quite ſo high a reliſh as in winter: At any rate, however, there can

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can be no doubt, that if ever it could be neceffary, it might, even now, be employed very properly as a feeding for cattle."

368 Culture of the roota baga in Nottinghamfhire.

This vegetable, from its obvious utility, is gradually coming to be much ufed in various quarters of the ifland. In the Agricultural Survey of Nottinghamfhire, the following defcription of the modes in which it has been fuccefsfully cultivated, is well worthy of attention. "The roota baga, or Swedifh turnip, is now cultivated by a few farmers in this diftrict. It appears to be fuperior to the common turnip in many refpects, particularly in hardinefs, as it ftood the laft fevere winter without the leaft injury. It is eaten with greedinefs by all animals, from the horfe to the fwine. Sheep prefer it to all others; but the material advantage that has been made of it, is the fubftituting it for corn in the food of draught horfes; in which it has been found to anfwer the wifh of every perfon who has yet tried it. The turnips are put into a tub or barrel, and cut fmall with an inftrument like a hoe, with the blade put perpendicularly into the fhaft; a man will cut in one hour as much as fix horfes can eat in twenty-four. The tops and bottoms are previoufly cut off and given to the pigs. Horfes that are hard worked, look full as well when fed with this turnip and very little hay, as they formerly did when very high fed with corn. The Swedifh turnip fhould be fowed early, from the 15th of May to the 10th of June."—The following information on the culture of the roota baga, is given in the fame Survey upon the authority of J. Daiken, Efq. of Nottingham.

Mr Daiken, about the 10th of May 1794, fowed about four acres with the feed of roota baga, about 2 lbs. per acre, on good fand land, worth 20s. an acre, manured as for turnips, and having been ploughed four or five times; the reft of the field, to the amount of nine acres in all, with common turnip and turnip-rooted cabbage, all broad-caft. They were not tranfplanted, but hoed out nine inches afunder, at three hoeings, at 7s. 6d. an acre; no other culture. In November, began to ufe them for horfes, giving at firft clover and rye-grafs hay, oats and beans; but finding that the horfes did well upon them, left off all corn, and continued them on hay and the roots only; fifteen were thus fed for about two months, were conftantly hard worked, and preferved themfelves in very good condition. Mr Daiken is fo well convinced, that in this application they were worth 30l. an acre, that he would in future, if he could not get them otherwife, rather give that fum per acre for one or two acres, than not have them for this ufe. They loft their leaves entirely when the froft fet in; but the roots were not the leaft affected, though the common turnips in the fame field were totally deftroyed. Paffengers paffing through the field, cut holes in them, which did not let the froft injure them; nor were thofe hurt which were damaged by cattle biting them. Some came to the weight of 16 lbs. and Mr Daiken thinks the average of the crop 8 lbs. and much to exceed in tonnage per acre common turnips.

Mr Daiken gave them alfo to hogs, cattle and fheep. They are excellent for hogs; and fheep being let into the field before the common turnips were deftroyed, gave fo decided a preference to the roota baga, that they would not fettle on the common turnips while the others were to be had.

The method of giving them to horfes is to cut off the top-root, to wafh them, and to cut them roughly with a perpendicular hoe, and then given directly, without keeping them to dry. The horfes ate them with avidity, and feemed even to prefer them to corn. Their qualities appear to be fingular, as they bind horfes inftead of relaxing them as other roots do. One mare was kept entirely upon them and ftraw, worked every day, did well, and never looked better; this mare was more bound by them than the reft. They have a ftrong effect upon making the coats fine; and one or two affected by the greafe, were cured by them, as they act as a ftrong diuretic. In this mode of application, one acre maintained fifteen about two months: and Mr Daiken is fo well convinced of the utility of the plant, as well as many of his neighbours, that he intends, and they alfo, to increafe the cultivation much.

Mr Daiken fufpects there are two forts of the roota baga, becaufe fome, upon cutting, are white within, but in general yellow; otherwife of the fame external appearance. The yellow is the beft.

3. Turnip Cabbage.

This plant is as yet but little known. The feed is faid to have been brought from the Cape of Good Hope by Mr Haftings, where it is very common as well as in Holland. It has alfo had an exiftence in Britain for many years, though not generally known. It has a much greater affinity to the cabbage than to the turnip; and is very hardy, bearing the winter as well, if not better, than common brocoli, and may therefore be confidered as a valuable acquifition to the 369

kitchen garden as well as for cattle. The beft time Method of cultivation.

for fowing it for the garden is the end of May or beginning of June, though none of the plants have ever been obferved to run to feed though fown ever fo early. Even though fown in Auguft at the cauliflower feafon, the greater part ftood throughout the following fummer, and did not feed till the fecond fpring. The plants require nearly the fame management with brocoli as to diftance, tranfplanting, &c. and are ufually moft efteemed when young, and about the fize of a moderate garden turnip; thofe fown in June will continue all winter. The bulb muft be ftripped clean of its thick fibrous rind; after which it may be ufed as a common turnip. The crown or fprout is very good, but efpecially in the fpring, when they begin to run to feed. Mr Broughton, from whofe account in the Bath Papers, vol. v. this article is taken, thinks that the turnip-cabbage is more nutritious than the common turnip. The largeft bulb he meafured was 23 inches circumference; but the thicknefs of the rind is fo great, that fome farmers imagined that the bulb would be too hard for fheep. The objection, however, was obviated by Mr Broughton, who gave fome of the oldeft and tougheft bulbs to his fheep, and found that they not only penetrated through the rind, but even devoured the greateft part of it.

4. Cabbage.

The cabbage has been recommended by long experience

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rience as an excellent food for cattle. Its uses as part of human food are also well known. It is therefore an interesting article in husbandry. It is easily raised, is subject to few diseases, resists frosts more than turnip, is palatable to cattle, and sooner fills them than turnip, carrot, or potatoes.

370 Culture of cabbage.

The season for setting cabbage depends on the use it is intended for. If intended for feeding in November, December, and January, plants procured from seed sown the end of July the preceding year must be set in March or April. If intended for feeding in March, April, and May, the plants must be set the first week of the preceding July, from seed sown in the end of February or beginning of March the same year. The late setting of the plants retards their growth; by which means they have a vigorous growth the following spring. And this crop makes an important link in the chain that connects winter and summer green food. Where cabbage for spring food happens to be neglected, a few acres of rye, sown at Michaelmas, will supply the want. After the rye is consumed, there is time sufficient to prepare the ground for turnip.

And now to prepare a field for cabbage. Where the plants are to be set in March, the field must be made up after harvest in ridges three feet wide. In that form let it lie all winter, to be mellowed with air and frost. In March, take the first opportunity, between wet and dry, to lay dung in the furrows. Cover the dung with a plough, which will convert the furrow into a crown, and consequently the crown into a furrow. Set the plants upon the dung, distant from each other three feet. Plant them so as to make a straight line cross the ridges, as well as along the furrows, to which a gardeners line stretched perpendicularly cross the furrows will be requisite. This will set each plant at the distance precisely of three feet from the plants that surround it. The purpose of this accuracy is to give opportunity for ploughing not only along the ridges, but cross them. This mode is attended with three signal advantages: it saves hand-hoeing, it is a more complete dressing to the soil, and it lays earth neatly round every plant.

If the soil be deep and composed of good earth, a trench ploughing after the preceding crop will not be amiss; in which case, the time for dividing the field into three-feet ridges, as above, ought to be immediately before the dunging for the plants.

If weeds happen to rise so close to the plants as not to be reached by the plough, it will require very little labour to destroy them with a hand-hoe.

Unless the soil be much infested with annuals, twice ploughing after the plants are set will be a sufficient dressing. The first removes the earth from the plants; the next, at the distance of a month or so, lays it back.

Where the plants are to be set in July, the field must be ribbed as directed for barley. It ought to have a slight ploughing in June before the planting, in order to loosen the soil, but not so as to bury the surface-earth; after which the three-feet ridges must be formed, and the other particulars carried on as directed above with respect to plants that are to be set in March.

In a paper already quoted from those of the Bath Society, Scots cabbages are compared, as to their utility in feeding cattle, with turnips, turnip-rooted cabbage, and carrots. In this trial the cabbages stand next in value to the carrots; and they are recommended as not liable to be affected by frost, if they be of the true flat-topped firm kind. Fifty-four tons have been raised upon an acre of ground not worth more than 12 shillings. There is likewise an advantage attending the feeding of cattle with cabbages, viz. that their dung is more in proportion than when fed with turnips or with hay; the former going off more by urine, and the latter having too little moisture. They also impoverish the ground much less than grain. Mr Billingsley accounts 46 tons per acre a greater crop than he ever read of; but Mr Vagg, in the 4th volume of Bath Papers, gives an account of a crop for which he received a premium from the Society, which was much superior to that of Mr Billingsley. Its extent was 12 acres; the produce of the worst was 42, and of the best 68 tons. They were manured with a compost of lime, weeds, and earth, that lay under the hedges round the field, and a layer of dung, all mixed and turned together. About 25 cart loads of this were spread upon an acre with the usual ploughing given to a common summer fallow; but for this, he says, "admitting such crop to exhaust the manure in some degree by its growth, an ample restoration will be made by its refuse ploughed in, and by the stirring and cleaning of the ground." The whole expence of an acre, exclusive of the rent, according to Mr Vagg's calculation, amounts to 1l. 14s. 1d. only four ounces of seed being requisite for an acre. The 12 acres, producing as above mentioned, would feed 45 oxen, and upwards of 60 sheep, for three months; improving them as much as the grass in the best months of the year, May, June, and July. He recommends sowing the seed about the middle of August, and transplanting the young cabbages where they may be sheltered from the frost; and to the neglect of this he ascribes the partial failure, or at least inferiority of one part of his ground in the crop just mentioned, the young plants not being removed till near midsummer, and then in so dry a time, that they were almost scorched up.

371 Quantity raised on an acre, &c.

372 Of watering cabbages.

In the Farmer's Magazine, vol. ii. p. 217. we have several pertinent remarks upon the culture of this useful plant, particularly with regard to watering. "It is a rule (says this correspondent) never to water the plants, let the season be as dry as it may; insisting that it is entirely useless. If the land is in fine tilth and well dunged, this may be right, as the expence must be considerable; but it is probable, in very dry seasons, when the new set plants have nothing but a burning sun on them, that watering would save vast numbers, and might very well answer the expence, if a pond is near, and the work done with a water-cart." He takes notice also of another use of cabbages, which has not met with the attention it merits, *viz.* the planting of lands where turnips have failed. A late sown crop of these seldom turns to any account; but cabbages planted on the ground without any ploughing would prove very beneficial for sheep late in the spring; in all probability (unless on light, sandy, or limestone soils) of greater value than the turnips, had they succeeded.

Mr Marshall observes, that in the midland district, a valuable

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valuable sort of large green cabbage "is propagated, if not raised, by Mr Bakewell, who is not more celebrated for his breed of rams than for his breed of cabbages. Great care is observed here in raising the seed, being careful to suffer no other variety of the brassica tribe to blow near seed cabbages; by which means they are kept true to their kind. To this end, it is said that some plant them in a piece of wheat; a good method, provided the seed in that situation can be preserved from birds."

373 Cabbages cultivated in the midland district.

374 Distance at which they ought to be placed.

The advantage of having large cabbages is that of being able to plant them wide enough from each other, to admit of their being cleaned with the plough, and yet to afford a full crop. The proper distance depends in some measure on the natural size of the species and the strength of the soil; the thinner they stand, the larger they will grow: but our author is of opinion that cabbages, as well as turnips, are frequently set out too thin. Four feet by two and a half, according to Mr Marshall, are a full distance for large cabbages on a rich soil.

375 Method of transplanting and earthing them. *Annals of Agriculture*, vol. xv.

We think it of importance to take notice of the following mode of transplanting cabbages, or earthing them, as being consistent with the best mode of practice, and coming from the most respectable practical authority, Mr George Cully of Fenton. "We plant the cabbages, says he, not only in right lines but equidistant every way, so that we can plough between the rows, both long-ways and cross over; which, by loosening the earth so effectually on all sides, very much promotes their growth. But the matter I wished to inform you of, is the taking them up by the roots in the autumn whenever they have completed their growth, and putting them into the nearest stubble field you have, where a plough is ready to draw a straight furrow in the most convenient place; and at twenty yards distance, more or less, the ploughman makes another furrow parallel to the first. The cabbages are now turned out of the carts as conveniently as may be for a sufficient number of women to lay them along these furrows as close one to another as possible. The ploughman begins again where he first started, and turns a large furrow upon the cabbages which is trodden down and righted by one, two, or more as occasion requires, with each a spade in his hand to assist where the plough has by chance or accident not thrown earth enough. Thus the work goes on till all is finished."

"We think we derive two advantages by the above process. In the first place the cabbages keep sufficiently well through the winter in their new situation, while they do not draw or exhaust the land so much where they were growing: and, secondly, that land is at liberty to be sown with wheat as soon as cleared of the cabbages; which grain, in general, answers well after that green crop."

376 How protected from caterpillars.

Cabbages and greens in general are apt to be infested by caterpillars. They may usually however be protected against those vermin by pulling off the large undermost leaves, which may be given to cows in the month of August, or when the common white butterflies begin to appear in numbers. These butterflies lay their eggs, which produce the cabbage caterpillar, on the under side of the largest leaves of the cabbage plants. There is also said to be another remedy. It consists of sowing beans among the cabbages, which will greatly prevent the breeding of these worms; for it is said that the butterflies have an antipathy to the flavour of beans.

Culture of Grass.

5. The Root of Scarcity.

377 Culture of the root of scarcity.

The *racine de disette*, or root of scarcity (*Betacicla*), delights in a rich loamy land well dunged. It is directed to be sown in rows, or broad-cast, and as soon as the plants are of the size of a goose quill, to be transplanted in rows of 18 inches distance, and 18 inches apart, one plant from the other: care must be taken in the sowing, to sow very thin, and to cover the seed, which lies in the ground about a month, an inch only. In transplanting, the root is not to be shortened, but the leaves cut at the top; the plant is then to be planted with a setting stick, so that the upper part of the root shall appear about half an inch out of the ground: this last precaution is very necessary to be attended to. These plants will strike root in twenty-four hours, and a man a little accustomed to planting will plant with ease 1800 or 2000 a day. In the seed-bed, the plants, like all others, must be kept clear of weeds: when they are planted out, after once hoeing, they will take care of themselves, and suffocate every kind of weed near them.

The best time to sow the seed is from the beginning of March to the middle of April: it is, however, advised to continue sowing every month until the beginning of July, in order to have a succession of plants. Both leaves and roots have been extolled as excellent both for man and beast. This plant is said not to be liable, like the turnip, to be destroyed by insects; for no insect touches it, nor is it affected by excessive drought, or the changes of seasons. Horned cattle, horses, pigs, and poultry, are exceedingly fond of it when cut small. The leaves may be gathered every 12 or 15 days; they are from 30 to 40 inches long, by 22 to 25 inches broad. This plant is excellent for milch cows, when given to them in proper proportions, as it adds much to the quality as well as quantity of their milk; but care must be taken to proportion the leaves with other green food, otherwise it would abate the milk, and fatten them too much, it being of so exceeding a fattening quality. To put all these properties beyond doubt, however, further experiments are wanting.

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378 Of laying down fields to grass.

The latter end of August, or the beginning of September, is the best season for sowing grass seeds, as there is time for the roots of the young plants to fix themselves before the sharp frosts set in. It is scarce necessary to say, that moist weather is best for sowing; the earth being then warm, the seed will vegetate immediately; but if this season prove unfavourable, they will do very well the middle of March following.

If you would have fine pasture, never sow on foul land. On the contrary, plough it well, and clear it from the roots of couch-grass, rest-harrow, fern, broom, and all other noxious weeds. If these are suffered to remain, they will soon get above and destroy your young grass. Rake these up in heaps, and burn them on the land, and spread the ashes as a manure. These ploughings and harrowings should be repeated in dry weather.

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weather. And if the ſoil be clayey and wet, make ſome under-drains to carry off the water, which, if ſuffered to remain, will not only chill the graſs, but make it ſour. Before ſowing, lay the land as level and fine as poſſible. If your graſs ſeeds are clean (which ſhould always be the caſe), three buſhels will be ſufficient per acre. When ſown, harrow it in gently, and roll it in with a wooden roller. When it comes up, fill up all the bare ſpots by freſh ſeed, which, if rolled to fix it, will ſoon come up and overtake the reſt.

In Norfolk they ſow clover with their graſſes, particularly with rye-graſs; but this ſhould not be done except when the land is deſigned for graſs only three or four years, becauſe neither of theſe kinds will laſt long in the land. Where you intend it for a continuance, it is better to mix only ſmall white Dutch clover, or marl graſs, with your other graſs ſeed, and not more than eight pounds to an acre. Theſe are abiding plants, ſpread cloſe on the ſurface, and make the ſweeteſt feed of any for cattle. In the following ſpring, root up thiſtles, hemlock, or any large plants that appear. The doing this while the ground is ſoft enough to permit your drawing them up by the roots, and before they ſeed, will ſave you infinite trouble afterwards.

The common method of proceeding in laying down fields to graſs is extremely injudicious. Some ſow barley with their graſſes, which they ſuppoſe to be uſeful in ſhading them, without conſidering how much the corn draws away the nouriſhment from the land.

Others take their ſeeds from a foul hay rick; by which means, beſides filling the land with rubbiſh and weeds, what they intend for dry ſoils may have come from moiſt, where it grew naturally, and *vice verſa*.

379 Different kinds of graſs.

The conſequence is, that the ground, inſtead of being covered with a good thick ſward, is filled with plants unnatural to it. The kinds of graſs moſt eligible for paſture lands are, the annual meadow, creeping, and fine bent, the fox's tail, and the creſted dog's tail, the poas, the feſcues, the vernal oat-graſs, and the ray or rye-graſs. We do not, however, approve of ſowing all theſe kinds together; for not to mention their ripening at different times, by which means you can never cut them all in perfection and full vigour, no kind of cattle are fond of all alike.

Horſes will ſcarcely eat hay which oxen and cows will thrive upon; ſheep are particularly fond of ſome kinds, and refuſe others. The darnel-graſs, if not cut before ſeveral of the other kinds are ripe, becomes ſo hard and wiry in the ſtalks, that few cattle care to eat it.

As the ſubject of paſtures is very important, we ſhall firſt take notice of the general mode of improving ordinary paſtures, and of the particular graſs plants that ought to be cultivated in them. After which we ſhall mention the celebrated modern improvements upon graſs lands, by flooding them artificially with water.

Paſture land is of ſuch advantage to huſbandry, that many prefer it even to corn land, becauſe of the ſmall hazard and labour that attends it; and as it lays the foundation for moſt of the profit that is expected from the arable land, becauſe of the manure afforded by the cattle which are fed upon it. Paſture ground is of two ſorts: the one is meadow land, which is often overflowed; and the other is upland, which lies high and dry. The firſt of theſe will produce a much greater quantity of hay than the latter, and will not require manuring or dreſſing ſo often: but then the hay produced on the upland is much preferable to the other; as is alſo the meat which is fed in the upland more valued than that which is fatted in rich meadows; though the latter will make the fatter and larger cattle, as is ſeen by thoſe which are brought from the low rich lands in Lincolnſhire. But where people are nice in their meat, they will give a much larger price for ſuch as hath been fed on the downs, or in ſhort upland paſture, than for the other, which is much larger. Beſides this, dry paſtures have an advantage over the meadows, that they may be fed all the winter, and are not ſo ſubject to poach in wet weather; nor will there be ſo many bad weeds produced; which are great advantages, and do in a great meaſure recompenſe for the ſmallneſs of the crop.

380 How to improve upland paſtures.

The firſt improvement of upland paſture is, by fencing it, and dividing it into ſmall fields of four, five, ſix, eight, or ten acres each, planting timber trees in the hedge-rows, which will ſcreen the graſs from the dry pinching winds of March, which will prevent the graſs from growing in large open lands; ſo that if April proves a dry month, the land produces very little hay; whereas in the ſheltered fields, the graſs will begin to grow early in March, and will cover the ground, and prevent the ſun from parching the roots of the graſs, whereby it will keep growing, ſo as to afford a tolerable crop if the ſpring ſhould prove dry. But in fencing of land the incloſure muſt not be made too ſmall, eſpecially where the hedge-rows are planted with trees; becauſe, when the trees are advanced to a conſiderable height, they will ſpread over the land; and where they are cloſe, will render the graſs ſo ſour, that inſtead of being of an advantage, it will greatly injure the paſture.

The next improvement of upland paſture is, to make the turf good, where, either from the badneſs of the ſoil, or for want of proper care, the graſs hath been deſtroyed by ruſhes, buſhes, or mole-hills. Where the ſurface of the land is clayey and cold, it may be improved by paring it off, and burning it; but if it is a hot ſandy land, then chalk, lime, marl, or clay, are very proper manures to lay upon it; but theſe ſhould be laid in pretty good quantities, otherwiſe they will be of little ſervice to the land.

If the ground is overrun with buſhes or ruſhes, it will be of great advantage to the land to grub them up towards the latter part of ſummer, and after they are dried to burn them, and ſpread the aſhes over the ground juſt before the autumnal rains; at which time the ſurface of the land ſhould be levelled, and ſown with graſs ſeed, which will come up in a ſhort time, and make good graſs the following ſpring. So alſo, when the land is full of mole-hills, theſe ſhould be pared off, and either burnt for the aſhes, or ſpread immediately on the ground when they are pared off, obſerving to ſow the bare patches with graſs ſeed juſt as the autumnal rains begin.

Where the land has been thus managed, it will be of great ſervice to roll the turf in the months of February and March with a heavy wooden roller; always obſerving to do it in moiſt weather, that the roller may make an impreſſion; this will render the ſurface level

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level, and make it much eaſier to mow the graſs than when the ground lies in hills; and will alſo cauſe the turf to thicken, ſo as to have what people uſually term a *good bottom*. The graſs likewiſe will be the ſweeter for this huſbandry, and it will be a great help to deſtroy bad weeds.

Another improvement of upland paſtures is, the feeding of them; for where this is not practiſed, the land muſt be manured at leaſt every third year; and where a farmer hath much arable land in his poſſeſſion, he will not care to part with his manure to the paſture. Therefore every farmer ſhould endeavour to proportion his paſture to his arable land, eſpecially where manure is ſcarce, otherwiſe he will ſoon find his error; for the paſture is the foundation of all the profit which may ariſe from the arable land.

Whenever the upland paſtures are mended by manure, there ſhould be a regard had to the nature of the ſoil, and a proper ſort of manure applied: as for inſtance, all hot ſandy land ſhould have a cold manure; neats dung and ſwines dung are very proper for ſuch lands; but for cold lands, horſe dung, aſhes, and other warm manures, are proper. And when theſe are applied, it ſhould be done in autumn, before the rains have ſoaked the ground, and rendered it too ſoft to cart on; and it ſhould be carefully ſpread, breaking all the clods as ſmall as poſſible, and then harrowed with buſhes, to let it down to the roots of the graſs. When the manure is laid on at this ſeaſon, the rains in winter will waſh it down, ſo that the following ſpring the graſs will receive the advantage of it.

There ſhould alſo be great care taken to deſtroy the weeds in the paſture every ſpring and autumn: for, where this is not practiſed, the weeds will ripen their ſeeds, which will ſpread over the ground, and thereby fill it with ſuch a crop of weeds as will ſoon overbear the graſs, and deſtroy it; and it will be very difficult to root them out after they have gotten ſuch poſſeſſion, eſpecially ragwort, and ſuch other weeds as have down adhering to their ſeeds.

The graſs which is ſown in theſe upland paſtures ſeldom degenerates, if the land is tolerably good: whereas the low meadows, on which water ſtagnates in winter, in a few years turn to a harſh ruſhy graſs, though the upland will continue a fine ſweet graſs for many years without renewing.

There is no part of huſbandry of which the farmers are in general more ignorant than that of the paſture: moſt of them ſuppoſe, that when old paſture is ploughed up, it can never be brought to have a good ſward again; ſo their common method of managing their land after ploughing, is to ſow with their crop of barley ſome graſs ſeeds as they call them; that is, either the red clover, which they intend to ſtand two years after the corn is taken off the ground, or rye-graſs mixed with trefoil; but as all theſe are at moſt but biennial plants, whoſe roots decay ſoon after their ſeeds are perfected, ſo the ground, having no crop upon it, is again ploughed for corn; and this is the conſtant round which the lands are employed in by the better ſort of farmers.

But whatever may have been the practice of theſe people, it is certainly poſſible to lay down lands which have been in tillage with graſs, in ſuch a manner as that the ſward ſhall be as good, if not better, than any natural graſs, and of as long duration. But this is never to be expected in the common method of ſowing a crop of corn with the graſs ſeeds; for, wherever this has been practiſed, if the corn has ſucceeded well, the graſs has been very poor and weak; ſo that if the land has not been very good, the graſs has ſcarcely been worth ſaving; for the following year it has produced but little hay, and the year after the crop is worth little, either to mow or feed. Nor can it be expected to be otherwiſe, for the ground cannot nouriſh two crops; and if there were no deficiency in the land, yet the corn, being the firſt and moſt vigorous of growth, will keep the graſs from making any conſiderable progreſs; ſo that the plants will be extremely weak, and but very thin, many of them which come up in the ſpring being deſtroyed by the corn; for wherever there are roots of corn, it cannot be expected there ſhould be any graſs. Therefore the graſs muſt be thin; and if the land is not in good heart to ſupply the graſs with nouriſhment, that the roots may branch out after the corn is gone, there cannot be any conſiderable crop of clover; and as their roots are biennial, many of the ſtrongeſt plants will periſh ſoon after they are cut; and the weak plants, which had made but little progreſs before, will be the principal part of the crop for the ſucceeding year; which is frequently not worth ſtanding.

381 How to ſow upland paſtures.

Therefore, when ground is laid down for graſs, there ſhould be no crop of any kind ſown with the ſeeds; or at leaſt the crop ſhould be ſown very thin, and the land ſhould be well ploughed and cleaned from weeds, otherwiſe the weeds will come up the firſt, and grow ſo ſtrong as to overbear the graſs, and if they are not pulled up, will entirely ſpoil it. The beſt ſeaſon to ſow the graſs ſeeds upon dry land, when no other crop is ſown with them, is about the middle of September or ſooner, if there is an appearance of rain: for the ground being then warm, if there happen ſome good ſhowers of rain after the ſeed is ſown, the graſs will ſoon make its appearance, and get ſufficient rooting in the ground before winter: ſo will not be in danger of having the roots turned out of the ground by froſt, eſpecially if the ground is well rolled before the froſt comes on, which will preſs it down, and fix the earth cloſe to the roots. Where this hath not been practiſed, the froſt has often looſened the ground ſo much, as to let in the air to the roots of the graſs, and done it great damage; and this has been brought as an objection to the autumnal ſowing of graſs; but it will be found to have no weight if the above direction is practiſed: nor is there any hazard of ſowing the graſs at this ſeaſon, but that of dry weather after the ſeeds are ſown; for if the graſs comes up well, and the ground is well rolled in the end of October, or the beginning of November, and repeated again the beginning of March, the ſward will be cloſely joined at bottom, and a good crop of hay may be expected the ſame ſummer. But where the ground cannot be prepared for ſowing at that ſeaſon, it may be performed the middle or latter end of March, according to the ſeaſon's being early or late; for, in backward ſprings, and in cold land, we have often ſowed the graſs in the middle of April with ſucceſs; but there is danger, in ſowing late, of dry weather, and eſpecially if the land is light and dry; for we have ſeen many times

times the whole ſurface of the ground removed by ſtrong winds at that ſeaſon; ſo that the ſeeds have been driven in heaps to one ſide of the field. Therefore, whenever the ſeeds are ſown late in the ſpring, it will be proper to roll the ground well ſoon after the ſeeds are ſown, to ſettle the ſurface, and prevent its being removed.

The ſorts of ſeeds which are the beſt for this purpoſe, are, the beſt ſort of upland hay ſeeds, taken from the cleaneſt paſtures, where there are no bad weeds; if this ſeed is ſifted to clean it from rubbiſh, three buſhels will be ſufficient to ſow an acre of land. The other ſort is the *trifolium pratenſe album*, which is commonly known by the names *white Dutch clover*, or *white honeyſuckle graſs*. Eight pounds of this ſeed will be enough for one acre of land. The graſs ſeed ſhould be ſown firſt, and then the Dutch clover ſeed may be afterwards ſown; but they ſhould not be mixed together, becauſe the clover ſeeds being the heavieſt will fall to the bottom, and conſequently the ground will be unequally ſown.

When the ſeeds are come up, if the land ſhould produce many weeds, theſe ſhould be drawn out before they grow ſo tall as to overbear the graſs; for where this has been neglected, the weeds have taken ſuch poſſeſſion of the ground as to keep down the graſs, and ſtarve it; and when theſe weeds have been ſuffered to remain until they have ſhed their ſeeds, the land has been ſo plentifully ſtocked with them as entirely to deſtroy the graſs; therefore it is one of the principal parts of huſbandry never to ſuffer weeds to grow on the land.

382 Advantages of rolling graſs.

If the ground is rolled two or three times at proper diſtances after the graſs is up, it will preſs down the graſs, and cauſe it to make a thicker bottom; for, as the Dutch clover will put out roots from every joint of the branches which are near the ground, ſo, by preſſing down of the ſtalks, the roots will mat ſo cloſely together, as to form a ſward ſo thick as to cover the whole ſurface of the ground, and form a green carpet, and will better reſiſt the drought. For if we do but examine the common paſtures in ſummer, in moſt of which there are patches of this white honeyſuckle graſs growing naturally, we ſhall find theſe patches to be the only verdure remaining in the fields. And this, the farmers in general acknowledge, is the ſweeteſt feed for all ſorts of cattle; yet never had any notion of propagating it by ſeeds, nor has this been long practiſed in England.

As the white clover is an abiding plant, ſo it is certainly the very beſt ſort to ſow, where paſtures are laid down to remain; for as the hay-ſeeds which are taken from the beſt paſtures will be compoſed of various ſorts of graſs, ſome of which may be but annual, and others biennial; ſo, when thoſe go off, there will be many and large patches of ground left bare and naked, if there is not a ſufficient quantity of the white clover to ſpread over and cover the land. Therefore a good ſward can never be expected where this is not ſown; for in moſt of the natural paſtures, we find this plant makes no ſmall ſhare of the ſward; and it is equally good for wet and dry land, growing naturally upon gravel and clay in moſt parts of England: which is a plain indication how eaſily this plant may be cultivated to great advantage in moſt ſorts of land throughout this kingdom.

Therefore the true cauſe why the land which has been in tillage is not brought to a good turf again, in the uſual method of huſbandry, is, from the farmers not diſtinguiſhing which graſſes are annual from thoſe which are perennial: for if annual or biennial graſſes are ſown, theſe will of courſe ſoon decay; ſo that, unleſs where ſome of their ſeeds may have ripened and fallen, nothing can be expected on the land but what will naturally come up. Therefore this, with the covetous method of laying down the ground with a crop of corn, has occaſioned the general failure of increaſing the paſture in many parts of Britain, where it is now much more valuable than any arable land.

After the ground has been ſown in the manner before directed, and brought to a good ſward, the way to preſerve it good is, by conſtantly rolling the ground with a heavy roller, every ſpring and autumn, as hath been before directed. This piece of huſbandry is rarely practiſed by farmers; but thoſe who do, find their account in it, for it is of great benefit to the graſs. Another thing ſhould alſo be carefully performed, which is, to cut up docks, dandelion, knapweed, and all ſuch bad weeds, by their roots every ſpring and autumn; this will increaſe the quantity of good graſs, and preſerve the paſtures in beauty. Dreſſing of theſe paſtures every third year is alſo a good piece of huſbandry; for otherwiſe it cannot be expected the ground ſhould continue to produce good crops. Beſides this, it will be neceſſary to change the ſeaſons of mowing, and not to mow the ſame ground every year, but to mow one ſeaſon and feed the next; for where the ground is every year mown, it muſt be conſtantly dreſſed, as are moſt of the graſs grounds near London, otherwiſe the ground will be ſoon exhauſted.

383 Culmiferous graſſes.

Culmiferous graſſes might be divided into two general claſſes for the purpoſes of the farmer, that it might be of uſe for him to attend to: viz. 1ſt, Thoſe which, like the common annual kinds of corn, run chiefly to ſeed-ſtalks; the leaves gradually decaying as they advance towards perfection, and becoming totally withered or falling off entirely when the ſeeds are ripe. Rye-graſs belongs to this claſs in the ſtricteſt ſenſe. To it likewiſe may be aſſigned the vernal graſs, dogs-tail graſs, and fine bent graſs. 2dly, Thoſe whoſe leaves continue to advance even after the ſeed-ſtalks are formed, and retain their verdure and ſucculence during the whole ſeaſon, as is the caſe with the feſcue and poa tribes of graſſes, whoſe leaves are as green and ſucculent when the ſeeds are ripe and the flower-ſtalks fading, as at any other time.

384 Culpable negligence of farmers about the proper kinds of graſſes.

"It is wonderful, Mr Stillingfleet ‡ remarks, to ſee how long mankind have neglected to make a proper advantage of plants of ſuch importance, and which, in almoſt every country, are the chief food of cattle. The farmer, for want of diſtinguiſhing and ſelecting graſſes for feed, fills his paſtures either with weeds or bad or improper graſſes; when, by making a right choice, after ſome trials, he might be ſure of the beſt graſs, and in the greateſt abundance that his land admits of. At preſent, if a farmer wants to lay down his land to graſs, what does he do? he either takes

‡ *Tracts relating to Nat. Hiſt.* &c.

his

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his feeds indifcriminately from his own foul hay rack, or fends to his next neighbour for a fupply. By this means, befides a certain mixture of all forts of rubbifh, which muft neceffarily happen, if he chances to have a large proportion of good feeds, it is not unlikely but that what he intends for dry land may come from moift, where it grew naturally, and the contrary. This is fuch a flovenly method of proceeding, as one would think could not poffibly prevail univerfally: yet this is the cafe as to all graffes except the darnel-grafs, and what is known in fome few counties by the name of the *Suffolk-grafs;* and this latter inftance is owing, I believe, more to the foil than any care of the hufbandman. Now, would the farmer be at the pains of feparating once in his life half a pint or a pint of the different kinds of grafs feeds, and take care to fow them feparately, in a very little time he would have wherewithal to ftock his farm properly, according to the nature of each foil, and might at the fame time fpread thefe feeds feparately over the nation, by fupplying the feed fhops. The number of graffes fit for the farmer is, I believe, fmall; perhaps half a dozen or half a fcore are all he need to cultivate; and how fmall the trouble would be of fuch a tafk, and how great the benefit, muft be obvious to every one at firft fight. Would not any one be looked on as wild who fhould fow wheat, barley, oats, rye, peafe, beans, vetches, buck-wheat, turnips, and weeds of all forts together? yet how is it much lefs abfurd to do what is equivalent in relation to graffes? Does it not import the farmer to have good hay and grafs in plenty? and will cattle thrive equally on all forts of food? We know the contrary. Horfes will fcarcely eat hay that will do well enough for oxen and cows. Sheep are particularly fond of one fort of grafs, and fatten upon it fafter than any other, in Sweden, if we may give credit to Linnæus. And may they not do the fame in Britain? How fhall we know till we have tried?"

385 Kinds of grafs commonly fown.

The graffes commonly fown for pafture, for hay, or to cut green for cattle, are red clover, white clover, yellow clover, rye-grafs, narrow-leaved plantain, commonly called *ribwort*, fainfoin, and lucerne.

Red clover is of all the moft proper to be cut green for fummer food. It is a biennial plant when fuffered to perfect its feed; but when cut green, it will laft three years, and in a dry foil longer. At the fame time the fafeft courfe is to let it ftand but a fingle year: if the fecond year's crop happen to be fcanty, it proves, like a bad crop of peafe, a great encourager of weeds by the fhelter it affords them.

Here, as in all other crops, the goodnefs of feed is of importance. Choofe plump feed of a purple colour, becaufe it takes on that colour when ripe. It is red when hurt in the drying, and of a faint colour when unripe.

386 Of red clover.

Red clover is luxuriant upon a rich foil, whether clay, loam, or gravel: it will grow even upon a moor, when properly cultivated. A wet foil is its only bane; for there it does not thrive.

To have red clover in perfection, weeds muft be extirpated, and ftones taken off. The mould ought to be made as fine as harrowing can make it; and the furface be fmoothed with a light roller, if not fufficiently fmooth without it. This gives opportunity for diftributing the feed evenly: which muft be covered by a fmall harrow with teeth no larger than thofe of a garden rake, three inches long, and fix inches afunder *. In harrowing, the man fhould walk behind with a rope in his hand fixed to the back part of the harrow, ready to difentangle it from ftones, clods, turnip or cabbage roots, which would trail the feed, and difplace it.

* Plate VIII. fig. 7.

Nature has not determined any precife depth for the feed of red clover more than of other feed. It will grow vigoroufly from two inches deep, and it will grow when barely covered. Half an inch may be reckoned the moft advantageous pofition in clay foil, a whole inch in what is light or loofe. It is a vulgar error, that fmall feed ought to be fparingly covered. Mifled by that error, farmers commonly cover their clover feed with a bufhy branch of thorn; which not only covers it unequally, but leaves part on the furface to wither in the air.

The proper feafon for fowing red clover, is from the middle of April to the middle of May. It will fpring from the firft of March to the end of Auguft; but fuch liberty ought not to be taken except from neceffity.

There cannot be a greater blunder in hufbandry than to be fparing of feed. Ideal writers talk of fowing an acre with four pounds. That quantity of feed, fay they, will fill an acre with plants as thick as they ought to ftand. This rule may be admitted where grain is the object; but it will not anfwer with refpect to grafs. Grafs feed cannot be fown too thick: the plants fhelter one another; they retain all the dew; and they muft pufh upward, having no room laterally. Obferve the place where a fack of peafe, or of other grain, has been fet down for fowing: the feed dropt there accidentally grows more quickly than in the reft of the field fown thin out of hand. A young plant of clover, or of fainfoin, according to Tull, may be raifed to a great fize where it has room; but the field will not produce half the quantity. When red clover is fown for cutting green, there ought not to be lefs than 24 pounds to an acre. A field of clover is feldom too thick: the fmaller a ftem be, the more acceptable it is to cattle. It is often too thin; and when fo, the ftems tend to wood.

Grain may be fown more fafely with red clover than with almoft any other grafs; and the moft proper grain has been found to be flax. The foil muft be highly cultivated for flax as well as for red clover. The proper feafon of fowing is the fame for both; the leaves of flax being very fmall, admit of free circulation of air; and flax being an early crop, is removed fo early as to give the clover time for growing. In a rich foil it has grown fo faft, as to afford a good cutting that very year. Next to flax, barley is the beft companion to clover. The foil muft be loofe and free for barley; and fo it ought to be for clover: the feafon of fowing is the fame; and the clover is well eftablifhed in the ground before it is overtopped by the barley. At the fame time, barley commonly is fooner cut than either oats or wheat. In a word, barley is rather a nurfe than a ftepmother to clover during its infancy. When clover is fown in fpring upon wheat, the foil which has lain five or fix months without being ftirred, is an improper bed for it; and the wheat, being in the vigour of growth, overtops

387 Of fowing clover with grain.

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overtops it from the beginning. It cannot be sown along with oats, because of the hazard of frost; and when sown as usual among the oats three inches high, it is overtopped, and never enjoys free air till the oats be cut. Add, that where oats are sown upon the winter furrow, the soil is rendered as hard as when under wheat.—Red clover is sometimes sown by itself without other grain: but this method, beside losing a crop, is not salutary; because clover in its infant state requires shelter.

As to the quantity of grain proper to be sown with clover: In a rich soil well pulverized, a peck of barley on an English acre is all that ought to be ventured; but there is not much soil in Scotland so rich. Two Linlithgow firlots make the proper quantity for an acre that produces commonly six bolls of barley; half a firlot for what produces nine bolls. To those who are governed by custom, so small a quantity will be thought ridiculous. Let them only consider, that a rich soil in perfect good order, will from a single seed of barley produce 20 or 30 vigorous stems. People may flatter themselves with the remedy of cutting barley green for food, if it happen to oppress the clover. This is an excellent remedy in a field of an acre or two; but the cutting an extensive field for food must be slow; and while one part is cutting, the clover is smothered in other parts.

388 White and yellow clover, ribwort, and rye-grass.

The culture of white clover, of yellow clover, of ribwort, of rye-grass, is the same in general with that of red clover. We proceed to their peculiarities. Yellow clover, ribwort, rye-grass, are all of them early plants, blooming in the end of April or beginning of May. The two latter are evergreens, and therefore excellent for winter pasture. Rye-grass is less hurt by frost than any of the clovers, and will thrive in a moister soil: nor in that soil is it much affected by drought. In a rich soil, it grows four feet high: even in the dry summer 1775, it rose to three feet eight inches; but it had gained that height before the drought came on. These grasses are generally sown with red clover for producing a plentiful crop. The proportion of seed is arbitrary; and there is little danger of too much. When rye-grass is sown for procuring seed, five firlots wheat measure may be sown on an acre; and for procuring seed of ribwort, 40 pounds may be sown. The roots of rye-grass spread horizontally: they bind the soil by their number; and though small, are yet so vigorous as to thrive in hard soil. Red clover has a large tap-root, which cannot penetrate any soil but what is open and free; and the largeness of the root makes the soil still more open and free. Rye-grass, once a great favourite, appears to be discarded in many parts of Britain. The common practice has been, to sow it with red clover, and to cut them promiscuously the beginning of June for green food, and a little later for hay. This indeed is the proper season for cutting red clover, because at that time the seed of the rye-grass is approaching to maturity, its growth is stopped for that year, as much as of oats or barley cut after the seed is ripe. Oats or barley cut green before the seed forms, will afford two other cuttings; which is the case of rye-grass, of yellow clover, and of ribwort. By such management, all the profit will be drawn that these plants can afford.

When red clover is intended for seed, the ground ought to be cleared of weeds, were it for no other purpose than that the seed cannot otherwise be preserved pure: what weeds escape the plough ought to be taken out by the hand. In England, when a crop of seed is intended, the clover is always first cut for hay. This appears to be done, as in fruit trees, to check the growth of the wood, in order to encourage the fruit. This practice will not answer in Scotland, as the seed would often be too late for ripening. It would do better to eat the clover with sheep till the middle of May, which would allow the seed to ripen. The seed is ripe when, upon rubbing it between the hands, it parts readily from the husk. Then apply the scythe, spread the crop thin, and turn it carefully. When perfectly dry, take the first opportunity of a hot day for threshing it on boards covered with a coarse sheet. Another way, less subject to risk, is to stack the dry hay, and to thresh it in the end of April. After the first threshing, expose the husks to the sun, and thresh them over and over till no seed remain. Nothing is more efficacious than a hot sun to make the husk part with its seed; in which view it may be exposed to the sun by parcels, an hour or two before the flail is applied.

White clover, intended for seed, is managed in the same manner. No plant ought to be mixed with rye-grass that is intended for seed. In Scotland, much rye-grass seed is hurt by transgressing that rule. The seed is ripe when it parts easily with the husk. The yellowness of the stem is another indication of its ripeness; in which particular it resembles oats, barley, and other culmiferous plants. The best manner to manage a crop of rye-grass for seed, is to bind it loosely in small sheaves, widening them at the bottom to make them stand erect; as is done with oats in moist weather. In that state they may stand till sufficiently dry for threshing. By this method they dry more quickly, and are less hurt by rain, than by close binding and putting the sheaves in shocks like corn. The worst way of all is to spread the rye-grass on the moist ground, for it makes the seed malten. The sheaves, when sufficiently dry, are carried in close carts to where they are to be threshed on a board, as mentioned above for clover. Put the straw in a rick when a hundred stone weight or so is threshed. Carry the threshing board to the place where another rick is intended; and so on till the whole seed be threshed, and the straw ricked. There is necessity for close carts to save the seed, which is apt to drop out in a hot sun; and, as observed above, a hot sun ought always to be chosen for threshing. Carry the seed in sacks to the granary or barn, there to be separated from the husks by a fanner. Spread the seed thin upon a timber floor, and turn it once or twice a-day till perfectly dry. If suffered to take a heat, it is useless for seed.

389 Culture of sainfoin.

The writers on agriculture reckon sainfoin preferable to clover in many respects: They say, that it produces a larger crop; that it does not hurt cattle when eaten green; that it makes better hay; that it continues four times longer in the ground; and that it will grow on land that will bear no other crop.

Sainfoin has a very long tap-root, which is able to pierce very hard earth. The roots grow very large; and the larger they are, they penetrate to the greater depth; and hence it may be concluded, that this grass, when

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when it thrives well, receives a great part of its nourifhment from below the *ftaple* of the foil: of courfe, a deep dry foil is beft for the culture of fainfoin. When plants draw their nourifhment from that part of the foil that is near the furface, it is not of much confequence whether their number be great or fmall. But the cafe is very different when the plants receive their food, not only near, but alfo deep below, the furface. Befides, plants that fhoot their roots deep are often fupplied with moifture, when thofe near the furface are parched with drought.

To render the plants of fainfoin vigorous, it is neceffary that they be fown thin. The beft method of doing this is by a drill; becaufe, when fown in this manner, not only the weeds, but alfo the fupernumerary plants, can eafily be removed. It is feveral years before fainfoin comes to its full ftrength; and the number of plants fufficient to ftock a field, while in this imperfect ftate, will make but a poor crop for the firft year or two. It is therefore neceffary that it be fown in fuch a manner as to make it eafy to take up plants in fuch numbers, and in fuch order, as always to leave in the field the proper number in their proper places. This can only be done, with propriety, by fowing the plants in rows by a drill. Suppofing a field to be drilled in rows at ten inches diftance, the partitions may be hand-hoed, and the rows dreffed in fuch a manner as to leave a proper number of plants. In this fituation the field may remain two years; then one-fourth of the rows may be taken out in pairs, in fuch a manner as to make the beds of fifty inches, with fix rows in each, and intervals of thirty inches, which may be ploughed. Next year, another fourth of the rows may be taken out in the fame manner, fo as to leave double rows with partitions of ten inches, and intervals of thirty: All of which may be hoed at once or alternately, as it may be found moft convenient.

The great quantity of this grafs which the writers on this fubject affure us may be raifed upon an acre, and the excellency and great value of the hay made of it, fhould induce farmers to make a complete trial of it, and even to ufe the fpade in place of the hoe, or hoe-plough, if neceffary.

The plants taken up from a field of fainfoin may be fet in another field; and if the tranfplanting of this grafs fucceeds as well as the tranfplanting of lucerne has done with M. Lunin de Chateauvieux, the trouble and expence will be fufficiently recompenfed by the largenefs of the crops. In tranfplanting, it is neceffary to cut off great part of the long tap-root: this will prevent it from ftriking very deep into the foil, and make it pufh out large roots in a floping direction from the cut end of the tap-root. Sainfoin managed in this manner, will thrive even on fhallow land that has a wet bottom, provided it be not overftocked with plants.

Whoever inclines to try the culture of this grafs in Scotland, fhould take great pains in preparing the land, and making it as free from weeds as poffible.

In England, as the roots ftrike deep in that chalky foil, this plant is not liable to be fo much injured by drought as other graffes are, whofe fibres ftrike horizontally, and lie near the furface. The quantity of hay produced is greater and better in quality than any other. But there is one advantage attending this grafs, which renders it fuperior to any other; and that arifes from feeding with it milch cows. The prodigious increafe of milk which it makes is aftonifhing, being nearly double that produced by any other green food. The milk is alfo better, and yields more cream than any other; and the butter procured from it is much better coloured and flavoured.

The following remarks by an Englifh farmer are made from much experience and obfervation.

399 Remarks on the culture of fainfoin in England.

Sainfoin is much cultivated in thofe parts where the foil is of a chalky kind. It will always fucceed well where the roots run deep; the worft foil of all for it is where there is a bed of cold wet clay, which the tender fibres cannot penetrate. This plant will make a greater increafe of produce, by at leaft 30 times, than common grafs or turf on poor land. Where it meets with chalk or ftone, it will extend its roots through the cracks and chinks to a very great depth in fearch of nourifhment. The drynefs is of more confequence than the richnefs of land for fainfoin; although land that is both dry and rich will always produce the largeft crops.

It is very commonly fown broad-caft; but it is found to anfwer beft in drills, efpecially if the land be made fine by repeated ploughing, rolling, and harrowing. Much depends on the depth at which this feed is fown. If it be buried more than an inch deep, it will feldom grow; and if left uncovered, it will pufh out its roots above ground, and thefe will be killed by the air. March and the beginning of April are the beft feafons for fowing it, as the feverity of winter and the drought of fummer are equally unfavourable to the young plants. A bufhel of feed fown broad-caft, or half that quantity in drills, if good, is fufficient for an acre. The drills fhould be 30 inches apart, to admit of horfe-hoeing between them. Much, however, depends on the goodnefs of the feed, which may be beft judged of by the following marks:

The hufk being of a bright colour, the kernel plump, of a gray or bluifh colour without, and if cut acrofs, greenifh and frefh withinfide; if it be thin and furrowed, and of a yellowifh caft, it will feldom grow. When the plants ftand fingle, and have room to fpread, they produce the greateft quantity of herbage, and the feed ripens beft. But farmers in general, from a miftaken notion of all that appears to be wafte ground being unprofitable, plant them fo clofe, that they choke and impoverifh each other, and often die in a few years. Single plants run deepeft and draw moft nourifhment; they are alfo eafieft kept free from weeds. A fingle plant will often produce half a pound of hay, when dry. On rich land this plant will yield two good crops in a year, with a moderate fhare of culture. A good crop muft not be expected the firft year; but, if the plants ftand not too thick, they will increafe in fize the fecond year prodigioufly.

No cattle fhould be turned on the field the firft winter after the corn is off with which it was fown, as their feet would injure the young plants. Sheep fhould not come on the following fummer, becaufe they would bite off the crown of the plants, and prevent their fhooting again. A fmall quantity of foapers afhes as a top-dreffing will be of great fervice, if laid on the firft winter.

3 If

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If the fainfoin be cut juft before it comes into bloom, it is admirable food for horned cattle; and if cut thus early, it will yield a fecond crop the fame feafon. But if it proves a wet feafon, it is better to let it ftand till its bloom be perfected; for great care muft be taken, in making it into hay, that the flowers do not drop off, as cows are very fond of them; and it requires more time than any other hay in drying. Sainfoin is fo excellent a fodder for horfes, that they require no oats while they eat it, although they be worked hard all the time. Sheep will alfo be fattened with it fafter than with any other food.

If the whole feafon for cutting proves very rainy, it is better to let the crop ftand for feed, as that will amply repay the lofs of the hay; becaufe it will not only fetch a good price, but a peck of it will go as far as a peck and a half of oats for horfes.

The beft time of cutting the feeded fainfoin is, when the greateft part of the feed is well filled, the firft blown ripe, and the laft blown beginning to open. For want of this care fome people have loft moft of their feed by letting it ftand too ripe. Seeded fainfoin fhould always be cut in a morning or evening, when the dews render the ftalks tender. If cut when the fun fhines hot, much of the feed will fall out and be loft.

391 Its excellence as food for cows.

An acre of very ordinary land, when improved by this grafs, will maintain four cows very well from the firft of April to the end of November; and afford, befides, a fufficient ftore of hay to make the greater part of their food the four months following.

If the foil be tolerably good, a field of fainfoin will laft from 15 to 20 years in prime; but at the end of feven or eight years, it will be neceffary to lay on a moderate coat of well-rotted dung; or, if the foil be very light and fandy, of marl. By this means the future crops, and the duration of the plants in health and vigour, will be greatly increafed and prolonged. Hence it will appear, that for poor land there is nothing equal to this grafs in point of advantage to the farmer.

Clover will laft only two years in perfection; and often, if the foil be cold and moift, near half the plants will rot, and bald patches be found in every part of the field the fecond year. Befides, from our frequent rains during the month of September, many crops left for feeding are loft. But from the quantity and excellent quality of this grafs (fainfoin), and its ripening earlier, and continuing in vigour fo much longer, much rifk and certain expence are avoided, and a large annual profit accrues to the farmer.

392 Culture of lucerne.

The writers on agriculture, ancient as well as modern, beftow the higheft encomiums upon lucerne as affording excellent hay, and producing very large crops. Lucerne remains at leaft 10 or 12 years in the ground, and produces about eight tons of hay upon the Scots acre. There is but little of it cultivated in Scotland. However, it has been tried in feveral parts of that country; and it is found, that, when the feed is good, it comes up very well, and ftands the winter froft. But the chief thing which prevents this grafs from being more ufed in Scotland, is the difficulty of keeping the foil open and free from weeds. In a few years the furface becomes fo hard, and the turf fo ftrong, that it deftroys the lucerne before the plants have arrived at their greateft perfection: fo that lucerne can fcarce be cultivated with fuccefs there, unlefs fome method be fallen upon of deftroying the natural grafs, and preventing the furface from becoming hard and impenetrable. This cannot be done effectually by any other means than horfe-hoeing. This method was firft propofed by Mr Tull, and afterwards practifed fuccefsfully by M. de Chateauvieux near Geneva. It may be of ufe therefore to give a view of that gentleman's method of cultivating lucerne.

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He does not mention any thing particular as to the manner of preparing the land; but only obferves in general, that no pains fhould be fpared in preparing it. He tried the fowing of lucerne both in rows upon the beds where it was intended to ftand, likewife the fowing it in a nurfery, and afterwards tranfplanting it into the beds prepared for it. He prefers tranfplanting; becaufe, when tranfplanted, part of the tap-root is cut off, and the plant fhoots out a number of lateral branches from the cut part of the root, which makes it fpread its roots nearer the furface, and confequently renders it more eafily cultivated: befides, this circumftance adapts it to a fhallow foil, in which, if left in its natural ftate, it would not grow.

The tranfplanting of lucerne is attended with many advantages. The land may be prepared in the fummer for receiving the plants from the nurfery in autumn; by which means the field muft be in a much better fituation than if the feed had been fown upon it in the fpring. By tranfplanting, the rows can be made more regular, and the intended diftances more exactly obferved; and confequently the hoeing can be performed more perfectly, and with lefs expence. M. Chateauvieux likewife tried the lucerne in fingle beds three feet wide, with fingle rows; in beds three feet nine inches wide, with double rows; and in beds four feet three inches wide, with triple rows. The plants in the fingle rows were fix inches afunder, and thofe in the double and triple rows were about eight or nine inches. In a courfe of three years he found, that a fingle row produced more than a triple row of the fame length. The plants of lucerne, when cultivated by tranfplantation, fhould be at leaft fix inches afunder, to allow them room for extending their crowns.

He further obferves, that the beds or ridges ought to be raifed in the middle; that a fmall trench, two or three inches deep, fhould be drawn in the middle; and that the plants ought to be fet in this trench, covered with earth up to the neck. He fays, that if the lucerne be fown in fpring, and in a warm foil, it will be ready for tranfplanting in September; that, if the weather be too hot and dry, the tranfplanting fhould be delayed till October; and that, if the weather be unfavourable during both thefe months, this operation muft be delayed till fpring. He further directs, that the plants fhould be carefully taken out of the nurfery, fo as not to damage the roots; that the roots be left only about fix or feven inches long; that the green crops be cut off within about two inches of the crown; that they be put into water as foon as taken up, there to remain till they are planted; and that they fhould be planted with a planting ftick, in the fame manner as cabbages.

He does not give particular directions as to the times of horfe-hoeing; but only fays, in general, that the

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the intervals ſhould be ſtirred once in the month during the whole time that the lucerne is in a growing ſtate. He likewiſe obſerves, that great care ought to be taken not to ſuffer any weeds to grow among the plants, at leaſt for the firſt two or three years; and for this purpoſe, that the rows, as well as the edges of the intervals where the plough cannot go, ſhould be weeded by the hand.

393 Culture of burnet.

Burnet is peculiarly adapted to poor land; beſides, it proves an excellent winter-paſture when hardly any thing elſe vegetates. Other advantages are, It makes good butter; it never blows or ſwells cattle; it is fine paſture for ſheep; and will flouriſh well on poor, light, ſandy, or ſtony ſoils, or even on dry chalk hills.

The cultivation of it is neither hazardous nor expenſive. If the land is prepared as is generally done for turnips, there is no danger of its failing. After the firſt year, it will be attended with very little expence, as the flat circular ſpread of its leaves will keep down, or prevent the growth of weeds.

On the failure of turnips, either from the fly or the black worm, ſome of our farmers have ſown the land with burnet, and in March following had a fine paſture for their ſheep and lambs. It will perfect its ſeed twice in a ſummer; and this ſeed is ſaid to be as good as oats for horſes; but it is too valuable to be applied to that uſe.

It is ſometimes ſown late in the ſpring with oats and barley, and ſucceeds very well; but it is beſt to ſow it ſingly in the beginning of July, when there is a proſpect of rain, on a ſmall piece of land, and in October following tranſplant it in rows two feet apart, and about a foot diſtant in the rows. This is a proper diſtance, and gives opportunity for hoeing the intervals in the ſucceeding ſpring and ſummer.

After it is fed down with cattle, it ſhould be harrowed clean. Some horſes will not eat it freely at firſt, but in two or theee days they are generally very fond of it. It affords rich pleaſant milk, and in great plenty.

A gentleman farmer near Maidſtone, ſome years ſince, ſowed four acres as ſoon as the crop of oats was got off, which was the latter end of Auguſt. He threw in 12 pounds of ſeed per acre, broad-caſt; and no rain falling until the middle of September, the plants did not appear before the latter end of that month. There was however a good crop; and in the ſpring he ſet the plants out with a turnip hoe, leaving them about a foot diſtant from each other. But the drill method is preferable, as it ſaves more than half the ſeed. The land was a poor dry gravel, not worth three ſhillings an acre for any thing elſe.

The ſevereſt froſt never injures this plant; and the oftener it is fed the thicker are its leaves, which ſpring conſtantly from its root.

We ſhall here enumerate a few more of the graſſes which have been accounted valuable, or are likely to become ſo.

394 Bulbous foxtail-graſs.

Alopecurus bulboſus, Bulbous Foxtail-grass, is recommended by Dr Anderſon *, as promiſing on ſome occaſions to afford a valuable paſture-graſs. It ſeems chiefly, he obſerves, to delight in a moiſt ſoil, and therefore promiſes to be only fit for a meadow paſture-graſs. The quality that firſt recommended it to his notice, was the unuſual firmneſs that its matted roots gave to the ſurface of the ground, naturally ſoft and moiſt, in which it grew; which ſeemed to promiſe that it might be of uſe upon ſuch ſoils, chiefly in preventing them from being much poached by the feet of cattle which might paſture upon them. Moſſy ſoils eſpecially are ſo much hurt by poaching, that any thing that promiſes to be of uſe in preventing it deſerves to be attended to.

* *Eſſays on Agriculture*, &c.

395 Great Meadow-graſs.

Poa pratenſis, Great Meadow-grass, ſeems to approach in many reſpects to the nature of the purple feſcue; only that its leaves are broader, and not near ſo long, being only about a foot or 16 inches at their greateſt length. Like it, it produces few ſeed ſtalks and many leaves, and is an abiding plant. It affects chiefly the dry parts of meadows, though it is to be found on moſt good paſtures. It is very retentive of its ſeeds, and may therefore be ſuffered to remain till the ſtalks are quite dry. It bloſſoms the beginning of June, and its ſeeds are ripe in July.

396 Creeping meadow-graſs.

Poa compreſſa, Creeping Meadow-grass, according to Dr Anderſon, ſeems to be the moſt valuable graſs of any of this genus. Its leaves are firm and ſucculent, of a dark Saxon-green colour; and grow ſo cloſe upon one another, as to form the richeſt pile of paſture-graſs. The flower-ſtalks, if ſuffered to grow, appear in ſufficient quantities; but the growth of theſe does not prevent the growth of the leaves, both advancing together during the whole ſummer; and when the ſtalks fade, the leaves continue as green as before. Its leaves are much larger and more abundant than the common meadow-graſs, *poa trivialis*; and therefore it better deſerves to be cultivated.

397 Vernal graſs.

Anthoxanthum odoratum, Vernal Grass, grows very commonly on dry hills, and likewiſe on ſound rich meadow-land. It is one of the earlieſt graſſes we have; and from its being found on ſuch kinds of paſtures as ſheep are fond of, and from whence excellent mutton comes, it is moſt likely to be a good graſs for ſheep paſtures. It gives a grateful odour to hay. In one reſpect, it is very eaſy to gather, as it ſheds its ſeeds upon the leaſt rubbing. A correſpondent of the Bath Society, however, mentions a difficulty that occurs in collecting them, owing to its being ſurrounded with taller graſſes at the time of its ripening, and being almoſt hid among them. If it be not carefully watched when nearly ripe, he obſerves, and gathered within a few days after it comes to maturity, great part of the ſeed will be loſt. The twiſted elaſtic awns, which adhere to the ſeed, lift them out of their receptacles with the leaſt motion from the wind, even while the ſtraw and ear remain quite erect. It is found moſtly in the moiſt parts of meadows; very little of it on dry paſtures. It flowers about the beginning of May, and is ripe about the middle of June.

398 Creſted dog's-tail graſs.

Cynoſurus criſtatus, Crested Dog's-tail grass. Mr Stillingfleet imagines this graſs to be proper for parks, from his having known one, where it abounds, that is famous for excellent veniſon. He recommends it alſo, from experience, as good for ſheep; the beſt mutton he ever taſted, next to that which comes from hills where the purple and ſheep's feſcue, the fine bent, and the ſilver hair graſſes abound, having been from ſheep fed with it. He adds, that it makes a very fine turf upon dry ſandy or chalky ſoils: but unleſs kept over with the ſcythe, its flowering-ſtems will look brown;

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brown; which is the caſe of all graſſes which are not fed on by variety of animals. For that ſome animals will eat the flowering ſtems is evident from commons, where ſcarcely any parts of graſſes appear but the radical leaves. This graſs is ſaid to be the eaſieſt of the whole group to collect a quantity of ſeed from. It flowers in June, and is ripe in July.

399 Cock's-tail, or feather graſs.

Stipa pennata, COCK'S-TAIL, or FEATHER GRASS.

400 Fine bent.

Agroſtis capillaris, FINE BENT, is recommended by Mr Stillingfleet, from his having always found it in great plenty on the beſt ſheep paſtures, in the different counties of England that are remarkable for good mutton. This graſs flowers and ripens its ſeed the lateſt of them all. It ſeems to be loſt the former part of the year, but vegetates luxuriantly towards the autumn. It appears to be fond of moiſt ground. It retains its ſeed till full ripe; flowers the latter end of July, and is ripe the latter end of Auguſt.

401 Mountain hair.

Areira flexuoſa, MOUNTAIN HAIR.

402 Silver hair.

——— *caryophillea*, SILVER HAIR.

The ſame may be ſaid of theſe two graſſes as of the preceding one.

403 Flote feſcue.

Feſtuca fluitans, FLOTE FESCUE. In a piece publiſhed in the Amœnitates Academicæ, vol. iii. entitled *Plantæ Eſculentæ*, we are informed, that "the ſeeds of this graſs are gathered yearly in Poland, and from thence carried into Germany, and ſometimes into Sweden, and ſold under the name of *manna ſeeds*.—Theſe are much uſed at the tables of the great, on account of their nouriſhing quality and agreeable taſte. It is wonderful (adds the author), that amongſt us theſe ſeeds have hitherto been neglected, ſince they are ſo eaſily collected and cleanſed." There is a clammineſs on the ear of the flote feſcue, when the ſeeds are ripe, that taſtes like honey; and for this reaſon perhaps they are called *manna ſeeds*.

Linnæus (*Flor. Suec.* art. 95.) ſays that the bran of this graſs will cure horſes troubled with botts, if kept from drinking for ſome hours.

Concerning this graſs we have the following information by Mr Stillingfleet. "Mr Dean, a very ſenſible farmer at Ruſcomb, Berkſhire, aſſured me that a field, always lying under water, of about four acres, that was occupied by his father when he was a boy, was covered with a kind of graſs, that maintained five farm horſes in good heart from April to the end of haveſt, without giving them any other kind of food, and that it yielded more than they could eat. He, at my deſire, brought me ſome of the graſs, which proved to be the flote feſcue with a mixture of the marſh-bent; whether this laſt contributes much towards furniſhing ſo good paſture for horſes, I cannot ſay. They both throw out roots at the joints of the ſtalks, and therefore are likely to grow to a great length. In the index of dubious plants at the end of Ray's Synopſis, there is mention made of a graſs under the name of *gramen caninum ſupinum longiſſimum*, growing not far from Saliſbury, 24 feet long. This muſt by its length be a graſs with a creeping ſtalk; and that there is a graſs in Wiltſhire growing in watery meadows, ſo valuable that an acre of it lets from 10 to 12 pounds, I have been informed by ſeveral perſons. Theſe circumſtances incline me to think it muſt be the flote feſcue; but whatever graſs it be, it certainly muſt deſerve to be inquired after.

Alopecurus pratenſis, MEADOW FOXTAIL. Linnæus ſays that this is a proper graſs to ſow on grounds that have been drained. Mr Stillingfleet was informed, that the beſt hay which comes to London is from the meadows where this graſs abounds. It is ſcarce in many parts of England, particularly Herefordſhire, Berkſhire, and Norfolk. It might be gathered at almoſt any time of the year from hay-ricks, as it does not ſhed its ſeeds without rubbing, which is the caſe of but few graſſes. It is among the moſt grateful of all graſſes to cattle. It is ripe about the latter end of June. 404 Meadow foxtail.

Poa annua, ANNUAL MEADOW GRASS. "This graſs (ſays Mr Stillingfleet) makes the fineſt of turfs. It grows everywhere by way ſides, and on rich ſound commons. It is called in ſome parts the *Suffolk graſs*. I have ſeen whole fields of it in High Suffolk without any mixture of other graſſes; and as ſome of the beſt ſalt butter we have in London comes from that county, it is moſt likely to be the beſt graſs for the dairy. I have ſeen a whole park in Suffolk covered with this graſs; but whether it affords good veniſon, I cannot tell, having never taſted of any from it. I ſhould rather think not, and that the beſt paſture for ſheep is alſo the beſt for deer. However, this wants trial. I remarked on Malvern-hill ſomething particular in relation to this graſs. A walk that was made there for the convenience of the water-drinkers, in leſs than a year was covered in many places with it, though I could not find one ſingle plant of it beſides in any part of the hill. This was no doubt owing to the frequent treading, which above all things makes this graſs flouriſh; and therefore it is evident that rolling muſt be very ſerviceable to it. It has been objected, that this graſs is not free from *bents*, by which word is meant the flowering-ſtems. I anſwer, that this is moſt certainly true, and that there is no graſs without them. But the flowers and ſtems do not grow ſo ſoon brown as thoſe of other graſſes; and being much ſhorter, they do not cover the radical leaves ſo much; and therefore this graſs affords a more agreeable turf without mowing than any other whatever that I know of." The ſeeds of this ſpecies drop off before they are dry, and to appearance, before they are ripe. The utmoſt care is therefore neceſſary in gathering the blades, without which very few of the ſeeds will be ſaved. It ripens from the middle of April, to ſo late, it is believed, as the end of October; but moſtly diſappears in the middle of the ſummer. It grows in any ſoil and ſituation, but rather affects the ſhade. 405 Annual meadow graſs.

A new graſs from America (named *Agroſtis cornucopiæ*), was ſome time ago much advertiſed and extolled, as poſſeſſing the moſt wonderful qualities, and the ſeeds of it were ſold at the enormous rate of 68l. the buſhel. But we have not heard that it has at all anſwered expection. On the contrary, we are informed by Dr Anderſon, in one of his publications*, that "it has upon trial been found to be good for nothing. Of the ſeeds ſown, few of them ever germinated: but enough of plants made their appearance, to aſcertain, that the graſs, in reſpect of quality, is among the pooreſt of the tribe; and that it is an *annual* plant, and altogether unprofitable to the farmer." 406 Agroſtis cornucopiæ.

* *Bee*, vol. i. p. 38.

Chicorium Intybus, Chicory. 407 Chicory.

Mr Arthur Young has anxiouſly endeavoured to diffuſe a knowledge of this plant, and he appears to have

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have been the firſt perſon that introduced it into the agriculture of England from France, where it grows naturally on the ſides of the roads and paths, and is ſometimes cultivated as a ſallad. When it has been ſown by itſelf, in ground prepared by good tillage, it has yielded two crops the ſame year. When ſown amongſt oats, no crop is expected till the following year. This plant defies the greateſt droughts, and reſiſts every ſtorm. Being of very early growth, its firſt leaves, which are large and tufted, ſpread ſidewiſe, and cover the ground ſo as to retain the moiſture and preſerve its roots from the heat which ſo often dries up every other vegetable production: it has not any thing to fear from ſtorms, for its thick and ſtiff ſtalks ſupport themſelves againſt the winds and heavieſt rains. The moſt ſevere cold and froſts cannot injure it. The quickneſs of its growth, above all, renders it moſt valuable, becauſe it furniſhes an abundance of ſalutary fodder in a ſeaſon, when the cattle, diſguſted with their dry winter food, greedily devour freſh plants.

This plant is greedily eaten by all ſorts of cattle, but it is difficult to make into hay. It is very voluminous, and drys ill, unleſs the weather be very favourable for it. The dry fodder, however, which it does yield, is eaten with pleaſure by the cattle. The following is the reſult of an experiment made with it by Mr Young upon an acre of ground

Annals of Agriculture, vol. xv.

ſown April 1788.

		Green produce. Tons	cwt.
	Cut July 24,	9	10
	October 17,	9	14
	Produce of the year of ſowing,	19	4
1789.	Cut May 21,	12	11
	July 24,	16	4
	December 3,	9	14
	Produce of the ſecond year,	38	9
1790.	Cut June 8,	18	15
	Auguſt 15,	19	9
	Produce of the third year,	38	4

The following Engliſh graſſes are recommended to attention by Mr Curtis, author of the *Flora Londinenſis*; and he has given directions for making experiments with graſs ſeeds in ſmall quantities.

408 Tall oat-graſs.

"*Avena elatior, tall oat-graſs;* common in wet meadows, and by the ſides of hedges, early, and very productive, but coarſe.

409 Yellow oat-graſs.

"*Avena flaveſcens, yellow oat-graſs;* affects a dry ſoil, is early and productive, bids fair to make a good ſheep paſture.

410 Rough oat-graſs.

"*Avena pubeſcens, rough oat-graſs;* ſoil and ſituation nearly ſimilar to that of the meadow feſcue, hardy, early, and productive.

411 Upright broom-graſs.

"*Bromus erectus, upright broom-graſs;* peculiar to chalky ſoils; early and productive; promiſes to be a good graſs for chalky lands, and thrives indeed very well on others.

412 Blue dogs-tail.

"*Cynoſurus cæruleus, blue dogs-tail graſs;* earlieſt of all the graſſes; grows naturally on the tops of the higheſt limeſtone rocks in the northern part of Great Britain: not very productive, yet may perhaps anſwer in certain ſituations, eſpecially as a graſs for ſheep: bears the drought of ſummer remarkably well: at all events ſeems more likely to anſwer than the *ſheeps feſcue graſs*, on which ſuch encomiums have, moſt unjuſtly, been laviſhed.

413 Rough cock's foot graſs.

"*Dactylis glomeratus, rough cock's-foot graſs;* a rough coarſe graſs, but extremely hard and productive: ſoil and ſituation the ſame as the *meadow-feſcue.*

414 Tall feſcue graſs.

"*Feſtuca elatior, tall feſcue graſs;* tall and coarſe, but very productive; affects wet ſituations.

415 Hard feſcue graſs.

"*Feſtuca duriuſcula, hard feſcue graſs;* affects ſuch ſituations as the *ſmooth-ſtalked meadow graſs;* is early and tolerably productive: its foliage is fine, and of a beautiful green; hence we have ſometimes thought it was of all others the fitteſt for a graſs-plat or bowling-green; but we have found, that though it thrives very much when firſt ſown or planted, it is apt to become thin, and die away after a while.

416 Meadow cat's-tail graſs.

"*Phleum pratenſe, meadow cats-tail graſs;* affects wet ſituations; is very productive, but coarſe and late."

To ſow graſs ſeeds in ſmall quantities, this author gives the following directions:—

417 Rules for making experiments with graſs feeds.

"If a piece of ground can be had, that is neither very moiſt nor very dry, it will anſwer for ſeveral ſorts of ſeed: they may then be ſown on one ſpot; but if ſuch a piece cannot be obtained, they muſt be ſown on ſeparate ſpots according to their reſpective qualities, no matter whether in a garden, a nurſery, or a field, provided it be well ſecured and clean. Dig up the ground, level and rake it, then ſow each kind of ſeed thinly in a ſeparate row, each row about a foot apart, and cover them over lightly with the earth; the latter end of Auguſt or beginning of September will be the moſt proper time for this buſineſs. If the weather be not uncommonly dry the ſeeds will quickly vegetate, and the only attention they will require will be to be carefully weeded. In about a fortnight from their coming up, ſuch of the plants as grow thickly together may be thinned, and thoſe which are taken up tranſplanted ſo as to make more rows of the ſame graſs.

"If the winter ſhould be very ſevere, though natives, as ſeedlings, they may receive injury; therefore it will not be amiſs to protect them with mats, fern, or by ſome other contrivance.

"Advantage ſhould be taken of the firſt dry weather in the ſpring, to roll or tread them down, in order to faſten their roots in the earth, which the froſt generally looſens: care muſt ſtill be taken to keep them perfectly clear from weeds. As the ſpring advances, many of them will throw up their flowering ſtems, and ſome of them will continue to do ſo all the ſummer. As the ſeed in each ſpike or pannicle ripens, it muſt be very carefully gathered and ſown in the autumn, at which time the roots of the original plants, which will now bear ſeparating, ſhould be divided, and tranſplanted, ſo as to form more rows; the roots of the ſmooth-ſtalked meadow-graſs, in particular, creeping like couch-graſs, may readily be increaſed in this way; and thus by degrees a large plantation of theſe graſſes may be formed and much ſeed collected.

"While the ſeeds are thus encreaſing, the piece or pieces

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pieces of ground, which are intended to be laid down, should be got in order. If very foul, perhaps the best practice (if pasture land) will be to pare off the sward and burn it on the ground: or if this should not be thought adviseable, it will be proper to plough up the ground and harrow it repeatedly, burning the roots of couch-grass and other noxious plants till the ground is become tolerably clean; to render it perfectly so, some cleansing crop, as potatoes or turnips, should be planted or sown.

"By this means, the ground we propose laying down will be got into excellent order without much loss; and being now ready to form into a meadow or pasture, should be sown broad-cast with the following compositions:

Meadow fox-tail, one pint;
Meadow fescue, ditto;
Smooth-stalked meadow, half a pint;
Rough stalked meadow, ditto;
Crested dog's-tail, a quarter of a pint;
Sweet-scented vernal, ditto;
Dutch clover (*trifolium repens*), half a pint;
Wild red clover (*trifolium pratense*), or in its stead,
Broad clover of the shops, ditto;

For wet land, the *crested dog's-tail* and *smooth-stalked meadow* may be omitted, especially the former.

"Such a composition as this, sown in the proportion of about three bushels to an acre on a suitable soil, in a favourable situation, will, I am bold to assert, form in two years a most excellent meadow; and, as all the plants sown are strong, hardy perennials, they will not easily suffer their places to be usurped by any noxious plants, which by manure or other means, in spite of all our endeavours, will be apt to insinuate themselves; if they should, they must be carefully extirpated; for such a meadow is deserving of the greatest attention: but if that attention cannot be bestowed on it, and in process of time weeds should predominate over the crop originally sown, the whole should be ploughed up, and fresh sown with the same seeds, or with a better composition, if such shall be discovered; for I have no doubt but at some future time, it will be as common to sow a meadow with a composition somewhat like this as it now is to sow a field with wheat or barley.

"One of the most important improvements in agriculture that has occurred of late years, is the practice of overflowing or flooding grass lands, which is now coming greatly into use, not only on level grounds, but in all situations in which a command of water can be obtained. In the Monthly Review for October 1788, the editors acknowledge the favour of a correspondent, who informed them, that watering of meadows was practised during the reigns of Queen Elizabeth and James I. A book was written upon the subject by one Rowland Vaughan, who seems to have been the inventor of this art, and who practised it on a very extensive plan in the Golden Valley in Herefordshire. Till this note to the Reviewers appeared, the inhabitants of a village called South Cerney in Gloucestershire had assumed the honour of the invention to themselves, as we are informed in a treatise upon the subject by the Rev. Mr Wright curate of the place. According to a received tradition in that village, watering of meadows has been practised there for about a century, and was introduced by one *Welladvise*, a wealthy farmer in South Cerney. His first experiment was by cutting a large ditch in the middle of his ground, from which he threw the water over some parts, and allowed it to stagnate in others; but finding this not to answer his expectations, he improved his method by cutting drains and filling up the hollows; and thus he succeeded so well, that his neighbours, who at first called him a madman, soon changed their opinion, and began to imitate his example.

418 When the watering of meadows was first practised in England.

419 Advantages of watering.

"The advantages which attend the watering of meadows are many and great; not only as excellent crops of grass are thus raised, but as they appear so early, that they are of infinite service to the farmers for food to their cattle in the spring before the natural grass rises. By watering we have plenty of grass in the beginning of March, and even earlier when the season is mild. The good effects of this kind of grass upon all sorts of cattle are likewise astonishing, especially upon such as have been hardly wintered; and Mr Wright informs us, that the farmers in his neighbourhood, by means of watering their lands, are enabled to begin the making of cheese at least a month sooner than their neighbours who have not the same advantage. Grass raised by watering is found to be admirable for the nurture of lambs; not only those designed for fattening, but such as are to be kept for store: For if lambs when very young are stopped and stinted in their growth, they not only become contracted for life themselves, but in some measure communicate the same diminutive size to their young. The best remedy for preventing this evil is the spring feed from watered meadows; and Mr Wright is of opinion, that if the young of all kinds of farmer's stock were immediately encouraged by plenty of food, and kept continually in a growing state, there would in a few years be a notable change both in the size and shape of cattle in general. Such indeed is the forwardness of grass from watered meadows, that the feed between March and May is worth a guinea per acre; and in June an acre will yield two tons of hay, and the after-math is always worth twenty shillings; and nearly the same quantity is constantly obtained whether the summer be dry or wet. In dry summers also, such farmers as water their meadows have an opportunity of selling their hay almost at any price to their neighbours.

420 Land constantly improves by watering.

"Land treated in this manner is continually improving in quality, even though it be mown every year: the herbage, if coarse at first, becomes finer; the soil, if swampy, becomes sound; the depth of its mould is augmented, and its quality meliorated every year. "To these advantages (says Mr Boswell in his treatise upon this subject) another may be addressed to the gentleman who wishes to improve his estate, and whose benevolent heart prompts him to extend a charitable hand to the relief of the industrious poor, and not to idleness and vice: almost the whole of the expence in this mode of cultivation is the actual manual labour of a class of people who have no genius to employ their bodily strength otherwise for their own support and that of their families; consequently when viewed in this light, the expence can be but comparatively small, the improvement great and valuable."

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421
Example of the produce of a watered meadow.

As a proof of the above doctrine, Mr Wright adduces an instance of one year's produce of a meadow in his neighbourhood. It had been watered longer than the eldest person in the neighbourhood could remember; but was by no means the best meadow upon the stream, nor was the preceding winter favourable for watering. It contains six acres and a half. The spring feed was let for seven guineas, and supported near 200 sheep from the 1st of March till the beginning of May: the hay being sold for 30 guineas, and the after-math for six. Another and still more remarkable proof of the efficacy of watering, is, that two of the most skilful watermen of that place were sent to lay out a meadow of seven acres, the whole crop of which was that year sold for two pounds. Though it was thought by many impossible to throw the water over it, yet the skill of the workmen soon overcame all difficulties; and ever since that time the meadow has been let at the rent of three pounds per acre. From manifold experience, our author informs us, that the people in that part of the country are so much attached to the practice of watering, that they never suffer the smallest spring or rivulet to be unemployed. Even those temporary floods occasioned by sudden showers are received into proper ditches, and spread equally over the lands until their fertilizing property be totally exhausted. "Necessity (says he) indeed compels us to make the most of every drop: for we have near 300 acres in this parish, that must all, if possible, be watered; and the stream that affords the water seldom exceeds five yards in breadth and one in depth: therefore we may say, that a scarcity of water is almost as much dreaded by us as by the celebrated inhabitants of the banks of the Nile."

422
The practice of watering ought to be more generally extended.

Considering the great advantages to be derived from the practice of watering meadows, and the many undoubted testimonies in its favour, Mr Wright expresses his surprise, that it has not come into more general use, as there is not a stream of water upon which a mill can be erected but what may be made subservient to the enriching of some land, perhaps to a great quantity. "I am confident (says he), that there are in each county of England and Wales 2000 acres upon an average which might be thus treated, and every acre increased at least one pound in annual value. The general adoption therefore of watering is capable of being made a national advantage of more than 100,000l. *per annum*, besides the great improvement of other land arising from the produce of the meadows and the employment of the industrious poor. Such an improvement, one would think, is not unworthy of public notice; but if I had doubled the sum, I believe I should not have exceeded the truth, though I might have gone beyond the bounds of general credibility. In this one parish where I reside there are about 300 acres now watered; and it may be easily proved that the proprietors of the land reap from thence 1000l. yearly profit."

In Mr Boswell's treatise upon this subject, published in 1790, the author complains of the neglect of the practice of improving the wet, boggy, and rushy lands, which lie at the banks of rivers, and might be meliorated at a very small expence, when much larger sums are expended in the improvement of barren uplands and large tracts of heath in various parts of the kingdom: and he complains likewise of the little information that is to be had in books concerning the method of performing this operation. The only author from whom he acknowledges to have received any information is Blyth; and even his method of watering is very different from that practised in modern times; for which reason he proposes to furnish an original treatise upon the subject; and of this we shall now give the substance.

423
Land capable of being watered.

The first thing to be considered is, what lands are capable of being watered. These, according to Mr Boswell, are all such as lie low, near the banks of rivulets and springs, especially where the water course is higher than the lands, and kept within its bounds by banks. If the rivulet has a quick descent, the improvement by watering will be very great, and the expences moderate. On level lands the water runs but slowly, which is also the case with large rivers; and therefore only a small quantity of ground can be overflowed by them in comparison of what can be done in other cases: but the water of large rivers is generally possessed of more fertilizing properties than that of rivulets. In many cases, however, the rivers are navigable, or have mills upon them; both of which are strong objections to the perfect improvement of lands adjacent to them. From these considerations, our author concludes, that the watering of lands may be performed in the best and least expensive manner by small rivulets and springs.

There are three kinds of soils commonly found near the banks of rivers and rivulets, the melioration of which may be attempted by watering. 1. A gravelly or sound warm firm soil, or a mixture of the two together. This receives an almost instantaneous improvement; and the faster the water runs over it the better. 2. Boggy, miry, and rushy soils, which are always found by the banks of rivers where the land is nearly level. These also are greatly improved by watering; perhaps equally so with those already described, if we compare the value of both in their unimproved state, this kind of ground being scarce worth any thing in its unimproved state. By proper watering, however, it may be made to produce large crops of hay, by which horned cattle may be kept through the winter and greatly forwarded; though, in its uncultivated state, it would scarce produce any thing to maintain stock in the winter, and very little even in summer. Much more skill, as well as expence, however, is requisite to bring this kind of land into culture than the former. 3. The soils most difficult to be improved are strong, wet, and clay soils; and this difficulty is occasioned both by their being commonly on a dead level, which will not admit of the water running over them; and by their tenacity, which will not admit of draining. Even when the utmost care is taken, unless a strong body of water is thrown over them, and that from a river the water of which has a very fertilizing property, little advantage will be gained; but wherever such advantages can be had in the winter, and a warm spring succeeds, these lands will produce very large crops of grass.

424
Springs and rivulets preferable to large rivers.

The advantage of using springs and rivulets for watering instead of large rivers is, that the expence of raising wares across them will not be great; nor are they liable to the other objections which attend the use

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ufe of large rivers. When they run through a cultivated country alfo, the land floods occafioned by violent rains frequently bring with them fuch quantities of manure as contribute greatly to fertilize the lands, and which are totally loft where the practice of watering is not in ufe.

Springs may be ufeful to the coarfe lands that lie near them, provided the water can be had in fufficient quantity to overflow the lands. "By fprings (fays our author), are not here meant fuch as rife out of poor heath or boggy lands (for the water iffuing from them is generally fo fmall in quantity, and always fo very lean and hungry in quality, that little if any advantage can be derived from it); but rather the head of rivulets and brooks rifing out of a chalky and gravelly found firm foil, in a cultivated country. Thefe are invaluable; and every poffible advantage fhould be taken to improve the ground near them. The author knows a confiderable tract of meadow-land under this predicament; and one meadow in particular that is watered by fprings iffuing immediately out of fuch a foil, without any advantage from great towns, &c. being fituated but a fmall diftance below the head of the rivulet, and the rivulet itfelf is fed all the way by fprings rifing out of its bed as clear as cryftal. The foil of the meadow is a good loam fome inches deep, upon a fine fpringy gravel. Whether it is from the heat of the fprings, or whether the friction by the water running over the foil raifes a certain degree of warmth favourable to vegetation, or from whatever caufe it arifes, the fecundity of this water is beyond conception; for when the meadow has been properly watered and well drained, in a warm fpring, the grafs has been frequently cut for hay within five weeks from the time the ftock was taken out of it, having eat it bare to the earth: almoft every year it is cut in fix weeks, and the produce from one to three waggon loads to an acre. In land thus fituated, in the mornings and evenings in the months of April, May, and June, the whole meadow will appear like a large furnace: fo confiderable is the fteam or vapour which arifes from the warmth of the fprings acted upon by the fun-beams: and although the water is fo exceeding clear, yet upon its being thrown over the land only a few days in warm weather, by dribbling through the grafs, fo thick a fcum will arife and adhere to the blades of the grafs, as will be equal to a confiderable quantity of manure fpread over the land, and (it may be prefumed from the good effects) ftill more enriching.

"It is inconceivable what 24 hours water properly conveyed over the lands will do in fuch a feafon: a beautiful verdure will arife in a few days where a parched rufty foil could only be feen; and one acre will then be found to maintain more ftock than ten could do before."

425 Explanation of the terms ufed in watering.

Mr Bofwell next proceeds to an explanation of the terms ufed in this art; of the inftruments neceffary to perform it; and of the principles on which it is founded. The terms ufed are:

1. A Ware. This is an erection acrofs a brook, rivulet, or river, frequently conftructed of timber, but more commonly of bricks or ftones and timber, with openings to let the water pafs, from two to ten in number according to the breadth of the ftream: the height being always equal to the depth of the ftream compared with the adjacent land. The ufe of this is occafionally to ftop the current, and to turn it afide into the adjacent lands.

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2. A Sluice is conftructed in the fame manner as a ware; only that it has but a fingle paffage for the water, and is put acrofs fmall ftreams for the fame purpofes as a ware.

3. A Trunk is defigned to anfwer the fame purpofes as a fluice; but being placed acrofs fuch ftreams as either cattle or teams are to pafs over, or where it is neceffary to carry a fmall ftream at right angles to a large one to water fome lands lower down, is for thefe reafons made of timber, and is of a fquare figure. The length and breadth are various, as circumftances determine.

4. A Carriage is made of timber or of brick. If of timber, oak is the beft; if of brick, an arch ought to be thrown over the ftream that runs under it, and the fides bricked up: But when made of timber, which is the moft common material, it is conftructed with a bottom and fides as wide and high as the main in which it lies. It muft be made very ftrong, clofe, and well jointed. Its ufe is to convey the water in one main over another, which runs at right angles to it; the depth and breadth are the fame with thofe of the main to which it belongs: and the length is determined by that which it croffes. The carriage is the moft expenfive inftrument belonging to watering.

5. A Drain-Sluice, or *Drain-Trunk*, is always placed in the lower part of fome main, as near to the head as a drain can be found; that is, fituated low enough to draw the main, &c. It is made of timber, of a fquare figure like a trunk, only much fmaller. It is placed with its mouth at the bottom of the main, and let down into the bank; and from its other end a drain is cut to communicate with fome trench-drain that is neareft. The dimenfions are various, and determined by circumftances. The ufe of it is, when the water is turned fome other way, to convey the leaking water that oozes through the hatches, &c. into the drain, that otherwife would run down into the tails of thofe trenches which lie loweft, and there poach and rot the ground, and probably contribute not a little to the making it more unfound for fheep. This operation is of the utmoft confequence in watering; for if the water be not thoroughly drained off the land, the foil is rotted; and when the hay comes to be removed, the wheels of the carriages fink, the horfes are mired, and the whole load fometimes fticks faft for hours together. On the other hand, when the drain trunks are properly placed, the ground becomes firm and dry, and the hay is fpeedily and eafily removed.

7. Hatches are beft made of oak, elm, or deal; the ufe of them is to fit the openings of wares, trunks, or fluices; and to keep back the water when neceffary, from paffing one way, to turn it another. They ought to be made to fit as clofe as poffible. When hatches belong to wares that are erected acrofs large ftreams, or where the ftreams fwell quickly with heavy rains, when the hatches are in their places to water the meadows they are fometimes made fo, that a foot or more of the upper part can be taken off, fo that vent may be given to the fuperfluous water, and yet enough retained for the purpofe of watering the meadows. In this

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this case, they are called *flood-hatches*: but Mr Boswell entirely disapproves of this construction, and recommends them to be made entire, though they should be ever so heavy, and require the assistance of a lever to raise them up. For when the water is very high, and the hatches are suddenly drawn up, the water falls with great force upon the bed of the ware, and in time greatly injures it: but when the whole hatch is drawn up a little way, the water runs off at the bottom, and does no injury.

8. A HEAD-MAIN, is a ditch drawn from the river, rivulet, &c. to convey the water out of its usual current, to water the lands laid out for that purpose, by means of lesser mains and trenches. The head-main is made of various dimensions, according to the quantity of land to be watered, the length or descent of it, &c. Smaller mains are frequently taken out of the head one; and the only difference is in point of size, the secondary mains being much smaller than the other. They are generally cut at right angles, or nearly so with the other, though not invariably. The use of the mains, whether great or small, is to feed the trenches with water, which branch out into all parts of the meadow, and convey the water to float the land. By some, these smaller mains are improperly called *carriages*.

9. A TRENCH is a small ditch made to convey the water out of the mains for the immediate purpose of watering the land. It ought always to be drawn in a straight line from angle to angle, with as few turnings as possible. It is never deep, but the width is in proportion to the length it runs, and the breadth of the plane between that and the trench-drain. The breadth tapers gradually to the lower end.

10. A TRENCH-DRAIN is always cut parallel to the trench, and as deep as the tail-drain water will admit, when necessary. It ought always, if possible, to be cut down to a stratum of sand, gravel, or clay. If into the latter, a spade's depth into it will be of great advantage. The use of it is to carry away the water immediately after it has run over the panes from the trench. It need not be drawn up to the head of the land by five, six, or more yards, according to the nature of the soil. Its form is directly the reverse of the trench; being narrower at the head, and growing gradually wider and wider until it empties itself into the tail-drain.

11. The TAIL-DRAIN is designed as a receptacle for all the water that flows out of the other drains, which are so situated that they cannot empty themselves into the river. It should run, therefore, nearly at right angles with the trenches, though generally it is thought most eligible to draw it in the lowest part of the ground, and to use it to convey the water out of the meadows at the place where there is the greatest descent; which is usually in one of the fence-ditches: and hence a fence-ditch is usually made use of instead of a tail-drain, and answers the double purpose of fencing a meadow, and draining it at the same time.

12. A PANE of ground is that part of the meadow which lies between the trench and the trench-drain; and in which the grass grows for hay. It is watered by the trenches, and drained by the trench-drains; whence there is a pane on each side of every trench.

13. A WAY-PANE is that part of the ground which lies in a properly watered meadow, on the side of the main where no trenches are taken out, but is watered the whole length of the main over its banks. A drain for carrying off the water from this pane runs parallel to the main. The use is to convey the hay out of the meadows, instead of the teams having to cross all the trenches.

14. A BEND is made in various parts of those trenches which have a quick descent, to obstruct the water. It is made, by leaving a narrow strip of green sward across the trench where the bend is intended to be left; cutting occasionally a piece of the shape of a wedge out of the middle of it. The use is to check the water, and force it over the trench into the panes; which, were it not for these bends, would run rapidly on in the trench, and not flow over the land as it passes along. The great art in watering consists in giving to each part of the panes an equal proportion of water.

15. A GUTTER is a small groove cut out from the tails of these trenches where the panes run longer at one corner than the other. The use is to carry the water to the extreme point of the pane. Those panes which are intersected by the trench and tail-drains, meeting in an obtuse angle, require the assistance of gutters to convey the water to the longest side. They are likewise useful, when the land has not been so well levelled, but some part of the panes lie higher than they ought: in which case, a gutter is drawn from the trench over that high ground, which otherwise would not be overflowed. Without this precaution, unless the flats be filled up (which ought always to be done when materials can be had to do it) the water will not rise upon it; and after the watering season is past, those places would appear rusty and brown, while the rest is covered with beautiful verdure. Our author, however, is of opinion, that this method of treating water meadows ought never to be followed; but that every inequality in water meadows should either be levelled or filled up. Hence the waterman's skill is shown in bringing the water over those places to which it could not naturally rise, and in carrying it off from those where it would naturally stagnate.

16. A CATCH-DRAIN is sometimes made use of when water is scarce. When a meadow is pretty long, and has a quick descent, and the water runs quickly down the drains, it is customary to stop one or more of them at a proper place, till the water flowing thither rises so high as to strike back either into the tail-drains so as to stagnate upon the sides of the panes, or till it flows over the banks of the drains, and waters the grounds below, or upon each side. It is then to be conveyed over the land in such quantity as is thought proper, either by a small main, out of which trenches are to be cut with their proper drains, or by trenches taken properly out of it. In case of a stagnation, the design will not succeed; and it will then be necessary to cut a passage to let the stagnating water run off. Even when the method succeeds best, Mr Boswell is of opinion, that it is not by any means eligible; the water having been so lately strained over the ground, that it is supposed by the watermen not to be endowed with such fertilizing qualities as at first; whence nothing but absolute necessity can justify the practice.

17. A POND is any quantity of water stagnating upon

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upon the ground, or in the tail-drain, trench-drains, &c. fo as to annoy the ground near them. It is occafioned fometimes by the flats not having been properly filled up; at others, when the ware not being clofe fhut, in order to water fome grounds higher up, the water is thereby thrown back upon the ground adjacent.

18. A TURN of water fignifies as much ground as can be watered at once. It is done by fhutting down the hatches in all thofe wares where the water is intended to be kept out, and opening thofe that are to let the water through them. The quantity of land to be watered at once muft vary according to circumftances; but Mr Bofwell lays down one general rule in this cafe, viz. that no more land ought to be kept under water at one time than the ftream can fupply regularly with a fufficient quantity of water; and if this can be procured, water as much ground as poffible.

19. The HEAD of the meadow, is that part of it into which the river, main, &c. firft enter.

20. The TAIL is that part out of which the river, &c. laft paffes.

21. The UPPER SIDE of a main or trench, is that fide which (when the main or trench is drawn at right angles, or nearly fo, with the river) fronts the part where the river entered. The lower fide is the oppofite.

22. The UPPER PANE in a meadow, is that which lies on the upper fide of the main or trench that is drawn at right angles with the river: where the river runs north and fouth, it enters in the former direction, and runs out in the fouthern, the main and trenches running eaft and weft. Then all thofe panes which lie on the north fide of the mains are called *upper* panes; and thofe on the fouth fide the *lower* panes. But when the mains, trenches, &c. run parallel to the river, there is no diftinction of panes into upper and lower.

The inftruments ufed in watering meadows are:

1. A *Water level*. The ufe of this is to take the level of the land at a diftance, and compare it with that of the river, in order to know whether the ground can be overflowed by it or not. This inftrument, however, is ufed only in large undertakings; for fuch as are on a fmaller fcale, the workmen difpenfe with it in the following manner: In drawing a main, they begin at the head, and work deep enough to have the water follow them. In drawing a tail drain, they begin at the lower end of it and work upwards, to let the tail water come after them. By this method we obtain the moft exact level.

1. The *Line*, *Reel*, and *Breaft-Plough*, are abfolutely neceffary. The line ought to be larger and ftronger than that ufed by gardeners.

3. *Spades*. Thofe ufed in watering meadows are made of a particular form, on purpofe for the work: having a ftem confiderably more crooked than thofe of any other kind. The bit is iron, about a foot wide in the middle, and terminating in a point: a thick ridge runs perpendicularly down the middle, from the ftem almoft to the point. The edges on both fides are drawn very thin, and being frequently ground and whetted, the whole foon becomes narrow; after which the fpades are ufed for trenches and drains; new ones being procured for other purpofes. The ftems being made crooked, the workmen ftanding in the trench or drain are enabled to make the bottoms quite fmooth and even.

4. *Wheel* and *Hand-barrows*. The former are ufed for removing the clods to the flat places, and are quite open, without any fides or hinder part. The latter are of fervice where the ground is too foft to admit the ufe of wheel-barrows, and when clods are to be removed during the time that the meadow is under water.

5. *Three-wheeled Carts* are neceffary when large quantities of earth are to be removed; particularly when they are to be carried to fome diftance.

6. Short and narrow *Scythes* are made ufe of to mow the weeds and grafs, when the water is running in the trenches, drains, and mains.

7. *Forks*, and long *Crooks* with four or five tines, are ufed for pulling out the roots of fedges, rufhes, reeds, &c. which grow in the large mains and drains. The crooks fhould be made light, and have long ftems to reach wherever the water is fo deep that the workmen cannot work in it.

8. Strong *Water-boots*, the tops of which will draw up half the length of the thigh, are indifpenfably neceffary. They muft alfo be large enough to admit a quantity of hay to be ftuffed down all round the legs, and be kept well tallowed to refift the running water for many hours together.

426 Principles on which the practice of watering depends.

The principles on which the practice of watering meadows depend are few and eafy.

1. Water will always rife to the level of the receptacle out of which it is originally brought.

2. There is in all ftreams a defcent greater or fmaller; the quantity of which is in fome meafure fhown by the running of the ftream itfelf. If it run fmooth and flow, the defcent is fmall; but if rapidly and with noife, the defcent is confiderable.

3. Hence if a main be taken out of the river high enough up the ftream, water may be brought from that river to flow over the land by the fide of the river, to a certain diftance below the head of the main, although the river from whence is is taken fhould, oppofite to that very place, be greatly under it.

4. Water, funk under a carraiage which conveys another ftream at right angles over it, one, two, or more feet below its own bed, will, when it has paffed the carrige, rife again to the level it had before.

5. Water conveyed upon any land, and there left ftagnant for any length of time, does it an injury; deftroying the good herbage, and filling the place with rufhes, flags, and other weeds.

6. Hence it is abfoutely neceffary, before the work is undertaken, to be certain that the water can be thoroughly drained off.

427 Wright's method.

In Mr Wright's treatife upon this fubject, the author confiders a folution of the three following queftions as a neceffary preliminary to the operation of watering. 1. Whether the ftream of water will admit of a temporary dam or ware acrofs it? 2. Can the farmer raife the water by this means a few inches above its level, without injuring his neighbour's land? 3. Can the water be drawn off from the meadow as quick as it is brought on? If a fatisfactory anfwer can be given

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to all thefe queftions, he directs to proceed in the following manner.

Having taken the level of the grouned, and compared it with the river, as directed by Mr Bofwell, cut a deep wide nich as near the dam as poffible, and by it convey the water directly to the higheft part of the meadow; keeping the fides or banks of the ditch of an equal height, and about three inches higher than the general furface of the meadow. Where the meadow is large, and has an uneven furface, it will fometimes be neceffary to have three works in different directions, each five feet wide, if the meadow contains 15 acres, and if the higheft part be fartheft from the ftream. A ditch of 10 feet wide and three deep will commonly water 10 acres of land. When there are three works in a meadow, and flood-hatches at the mouth of each, when the water is not fufficient to cover the whole completely at once, it may be watered at three different times, by taking out one of the hatches, and keeping the other two in. In this cafe, when the water has run over one divifion of the land for 10 days, it may then be taken off that and tumbled over to another, by taking up another hatch and letting down the former; by which means the three divifions will have a proper fhare of the water alternately, and each reap equal benefit. The bottom of the firft work ought to be as deep as the bottom of the river, when the fall in the meadow will admit of it; for the deeper the water is drawn, the more mud it carries along with it. From the works, cut at right angles, fmaller ditches or troughs, having a breadth proportioned to the diftance to which fome part of the water is to be carried, their diftance from each other being about 12 yards. A trough two feet wide and one foot deep, will water a furface 12 yards wide and 40 feet long. In each trough as well as ditch place frequent ftops and obftructions, efpecially when the water is rapid, to keep it high enough to flow through the notches or over the fides. Each ditch and trough is gradually contracted in width, as the quantity of water conftantly decreafes the farther they proceed. Between every two troughs, and at an equal diftance from both, cut a drain as deep as you pleafe parallel to them, and wide enough to receive all the water that runs over the adjacent lands, and to carry it off into the mafter-drain with fuch rapidity as to keep the whole fheet of water in conftant motion; and if poffible, not to fuffer a drop to ftagnate upon the whole meadow. "For a ftagnation, fays he, (though it is recommended by a Mr D. Young for the improvement of arable land), is what we never admit in our fyftem of watering; for we find that it rots the turf, foaks and ftarves the land, and produces nothing but coarfe grafs and aquatic weeds.

"When a meadow lies cold, flat, and fwampy, the width of the bed, or the diftance between the trough and drain, ought to be very fmall, never exceeding fix yards: indeed, in this cafe, you can fcarcely cut your land too much, provided the water be plentiful; for the more you cut, the more water you require. The fall of the bed in every meadow fhould be half an inch in a foot: lefs will do, but more is defirable; for when the draught is quick, the herbage is always fine and fweet. The water ought never to flow more than two inches deep, nor lefs than one inch, except in the warm months."

428 Objections to his method anfwered.

Mr Wright proceeds now to anfwer fome objections made by the Reviewers in their account of the firft edition of his work. 1. That the Gloucefterfhire farmers ufe more water for their lands than is neceffary. To this it is anfwered, That where water is plentiful, they find it advantageous to ufe even more water than he recommends; and when water is fcarce, they choofe rather to water only one half, or even a fmaller portion of a meadow at a time, and to give that a plentiful covering, than to give a fcanty one to the whole. 2. The Reviewers likewife recommend a repeated ufe of the fame water upon different and lower parts of the fame meadow, or to make each drain ferve as a trough to the bed which is below it. But though this method is in fome degree recommended by the celebrated Mr Bakewell, and taught by a fyftematic waterer in Staffordfhire, he entirely difapproves of it; excepting where the great declivity of the land will not admit of any other plan. "This cannot (fays he) be a proper mode of watering grafs-land in the winter time; for it can be of no fervice to the loweft parts of the meadow, unlefs as a wetting in fpring or fummer. The firft or higheft part of a meadow laid out according to this plan will indeed be much improved; the fecond may reap fome benefit; but the third, which receives the exhaufted thin cold water, will produce a very unprofitable crop. Our farmers never choofe more than a fecond ufe in the fame meadow, and that very feldom; they call even the fecond running by the fignificant name of *fmall beer;* which, they fay, may poffibly fatisfy thirft, but can give very little life or ftrength to land. It is a much better method to have a meadow laid out fo as to be watered at feveral times, and to be at the expence of feveral fmall flood-hatches, than to water the whole of it at once by means of catch-drains.

429 A repeated ufe of the fame water is not eligible.

"Sometimes it is neceffary, in a large meadow, to convey the water that has been ufed under the works and troughs; and then the water above is fupported by means of boards and planks, which we call a *carry-bridge*. Sometimes, the better to regulate the courfe of the water on the furface, efpecially in the fpring, narrow trenches are dug, and the mould laid by the fide of them, in order to be reftored to its former place when the watering is finifhed. The earth and mud thrown out in cleanfing and paring the ditches fhould be carried to fill up the low hollow parts of the meadow, and be trodden down with an even furface; which will eafily be done when the water is on, the waterman being always provided with a ftrong pair of water-proof boots. If the mould thus ufed has upon it a turf that is tolerably fine, place it uppermoft; but if it is fedgy and coarfe, turn it under, and the water if it runs quick will foon produce a fine herbage upon it.

"The grounds that are watered in the eafieft and moft effectual manner, are fuch as have been ploughed and ridged up in lands about twelve yards wide. Here the water is eafily carried along the ridge by means of a fmall ditch or trough cut along its fummit, and then, by means of the ftops in it, is made to run down the fides or beds into the furrows, by which it is carried into

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into the maſter-drain, which empties itſelf into the river. Every meadow, before it is well watered, muſt be brought into a form ſomething like a field that has been thus left by the plough in a ridged ſtate. Each ſide of the ridge ſhould be as nearly as poſſible an exact inclined plane, that the water may flow over it as equally as may be." Mr Wright does not, like Mr Boſwell, diſapprove of the uſe of flood-hatches; he only gives the following hint, viz. that their baſis ſhould be deep and firmly fixed, well ſecured with ſtone and clay, that it be not blown up. The following directions are given for each month of watering.

430 Of cleaning and repairing the works.

In the beginning of November, all the ditches, troughs, and drains, are to be thoroughly cleanſed by the ſpade and breaſt-plough, from weeds, graſs, and mud; and well repaired, if they have received any injury from cattle.

431 Thick and muddy water to be uſed when it can be done.

After a ſhower, when the water is thick and muddy, turn over the meadow as much water as you can without injuring the banks of the works, eſpecially if the land be poor; as in this month, according to our author, the water contains many more fertilizing particles, which he calls *ſalts* and *richneſs*, than later in the winter. In defence of this poſition, of which it ſeems the Monthly Reviewers have doubted, our author urges, that though he is not able to prove it by any chemical analyſis, yet it ſeems evident, that "after the firſt waſhing of farm yards, various ſinks, ditches, and the ſurface of all the adjoining fields, which have lain dry for ſome time, the common ſtream ſhould then contain much more fatneſs than when the ſame premiſes have been repeatedly waſhed." This is confirmed by the experience of the Glouceſterſhire farmers; who, if they can at this ſeaſon of the year procure plenty of muddy water to overflow their grounds for one week, look upon it to be equally valuable with what is procured during all the reſt of the winter. In ſupport of this, he quotes the following words of Mr Forbes, in a treatiſe on watering: "The water ſhould be let in upon the meadow in November, when the firſt great rains make it muddy, for then it is full of a rich ſediment, brought down from the lands of the country through which it runs, and is waſhed into it by the rain; and as the ſediment brought by the firſt floods is the richeſt, the carriages and drains of the meadow ſhould all be ſcoured clean and in order, before theſe floods come."

"In oppoſition (adds Mr Wright) to the opinion of practical waterers, that the muddineſs of the water is of little conſequence, I heſitate not to affirm, that the mud is of as much conſequence in winter-watering, as dung is in the improvement of a poor upland field. For each meadow in this neighbourhood is fruitful in proportion to the quantity of mud that it collects from the water. And, indeed, what can be conceived more enriching than the abundant particles of putrid matter which float in the water, and are diſtributed over the ſurface of the land, and applied home to the roots of the graſs. It is true, that any the moſt ſimple water thrown over a meadow in proper quantity, and not ſuffered to ſtagnate, will ſhelter it in winter, and in the warmth of ſpring will force a crop; but this unuſual force muſt exhauſt the ſtrength of the land, which will require an annual ſupply of manure in ſubſtance, or, in a courſe of years, the ſoil will be impaired rather than improved. The meadows in this county, which lie next below a market town or village, are invariably the beſt; and thoſe which receive the water after it has been two or three times uſed, reap proportionably leſs benefit from it: For every meadow that is well laid out, and has any quantity of graſs upon its ſurface, will act as a fine ſieve upon the water, which, though it flow in ever ſo muddy, will be returned back to the ſtream as clear as it came from the fountain. This circumſtance, when there is a range of meadows to be watered, the property of different perſons, when water is ſcarce, creates vehement contentions and ſtruggles for the firſt uſe of it. The proprietors are therefore compelled to agree among themſelves, either to have the firſt uſe alternately, or for the higher meadows to dam up, and uſe only one half or a leſs portion of the river. Our farmers know the mud to be of ſo much conſequence in watering, that whenever they find it collected at the bottom of the river, or the ditches, they hire men whole days to diſturb and raiſe it with rakes made for the purpoſe, that it may be carried down by the water, and ſpread upon their meadows. One meadow in South Cerney, I think, is an inconteſtible proof of the conſequence of muddy water. 432 Inſtance of the good effects of muddy water.

It is watered by a branch of the common ſtream that runs for about half a mile down a public road. This water, by the mud on the road being continually diſturbed by carriages and the feet of cattle, becomes very thick, and when it enters the meadow is almoſt as white as milk. This field, which conſiſts of ſeven acres, was a few years ago let for 10s. an acre, but is already become the richeſt land in the pariſh, and has produced at one crop eighteen loads of hay, and each load more than 25 hundred weight."

433 Mr Wimpey's opinion upon the ſubject.

In further confirmation of what our author aſſerts, he quotes, from the Annals of Agriculture, the following words of Mr Wimpey: "As to the ſorts of water, little is to be found, I believe, which does not encourage and promote vegetation, even the moſt ſimple, elementary, and uncompounded fluid: heat and moiſture, as well as air, are the *ſine qua non* of vegetation as well as animal life. Different plants require different proportions of each to live and flouriſh; but ſome of each is abſolutely neceſſary to all. However, experience as well as reaſon univerſally ſhows, that the more turbid, feculent, and replete with putreſcent matter the water is, the more rich and fertilizing it proves. Haſty and impetuous rains, of continuance ſufficient to produce a flood, not only diſſolve the ſalts, but waſh the manure in ſubſtance off the circumjacent land into the rapid current. Such turbid water is both meat and drink to the land; and, by the unctuous ſediment and mud it depoſits, the ſoil is amazingly improved and enriched. The virtue of water from a ſpring, if at all ſuperior to pure elementary water, is derived from the ſeveral ſtrata or beds of earth it paſſes through, which, according to the nature of ſuch ſtrata, may be friendly or otherwiſe to vegetation. If it paſſes through chalk, marl, foſſil ſhells, or any thing of a calcareous nature, it would in moſt ſoils promote the growth of plants; but if through metallic ores, or earth impregnated with the vitriolic acid, it would render the land unfertile, if not wholly barren. In general the water that has run far is ſuperior to that which immediately flows from the ſpring, and more eſpecially that which is feculent and muddy, conſiſting

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fifting chiefly of putrid animal fubftances wafhed down the ftream."

434 Confirmed by Mr Forbes.

To the fame purpofe alfo fays Mr Forbes: "There is great difference in the quality of water, arifing from the particles of different kinds of matter mixed with them. Thofe rivers that have a long courfe through good land, are full of fine particles, that are highly fertilizing to fuch meadows as are ufually overflowed by them; and this chiefly in floods, when the water is fulleft of a rich fediment: for when the water is clear, though it may be raifed by art high enough to overflow the adjoining lands, and be of fome fervice to them, the improvement thus made is far fhort of what is obtained from the fame water when it is thick and muddy."

435 Mr Bofwell's opinion.

Mr Bofwell, though quoted by Mr Wright as an advocate for the doctrine juft now laid down, feems, in one part of his work at leaft, to be of a contrary opinion. This is in the 14th chapter of his book, where he remarks upon another publication on the fame fubject, the name of which he does not mention: "In page 4. of that pamphlet (fays Mr Bofwell), the writer informs us, 'if the water ufed be always pure and fimple, the effect will by no means be equal to the above; that is, of a ftream that is fometimes thick and muddy. We have a ftriking inftance of this in two of our meadows, which are watered immediately from fprings that arife in the grounds themfelves. Their crops are early and plentiful, but not of a good quality, and the land remains unimproved after many years watering.'

"The writer of this treatife (Mr Bofwell), in a former edition, had afferted, and in this repeated, the contrary effects from a ftream very near the fpring-head, as clear as cryftal.

"The gentleman (Mr Beverly of Keld) whom that writer mentions in his preface, made a fhort vifit laft fpring into Dorfetfhire, to fatisfy himfelf of the fact. The editor had the pleafure to fhow him the ftream alluded to, which he traced almoft to the fountain-head. It was perfectly clear, and the water was then immediately conveyed out of the ftream upon the lands adjoining, fome of which it was then running over; others it had been upon, and the verdure was then appearing. The gentleman expreffed himfelf perfectly fatisfied with the fact. To him the editor wifhes to refer, &c. Mr George Culley of Fenton near Wooler in Northumberland, with a truly noble and public fpirit that does him great honour as a friend to his country, fent a very fenfible young man from thence into Dorfetfhire, to learn the art of watering meadows, and to work the whole feafon in thofe meadows under different watermen. This man was often over thofe meadows, and worked in fome juft below that were watered by the fame ftream. Might the editor prefume to offer his opinion upon this feeming contradiction, it is very probable that the foils, both the upper and under ftrata, are very different, as well as thofe through which the different fprings run."

From this paffage, the latter part of which is not very intelligible, we might conclude that Mr Bofwell prefers clear to muddy water for overflowing meadows. In his chapter on land-floods, however, he expreffes himfelf as follows: "They will (fays he) always be found of great ufe where the fweepings of towns, farm-yards, &c. are carried down by them; feldom any other erection is wanting befides a fluice or fmall ware to divert and convey them over the lands. If the fituation of the land happen to be on the fide of a hill, catch-drains are abfolutely neceffary for watering the lower part of the hill, after the water has been ufed upon the upper. In many parts of the kingdom, where there are large hills or extenfive rifing lands, great quantities of water run from them into the valleys after heavy rains: Thefe might with proper attention be collected together before they get to the bottom or flat ground, and from thence be diverted to the purpofe of watering thofe lands that lie below, with great advantage to the occupier, and at a fmall expence. And fhould the land thus fituated be arable, yet it would be found a beneficial exchange to convert it into pafture; particularly if pafture-ground fhould be a defirable object to the occupier.

436 Advantages of land-floods.

437 Of converting arable land into pafture.

The method of performing it is thus recommended. Obferve the piece of land or field beft adapted to the purpofe, both for fituation and foil. If it fhould be arable, make it firft very level; and with the crop of corn fow all forts of hay feeds; and as foon as it has got a green fward it may be laid out. In the loweft part of the ground draw a deep ditch for the current to run in through it; and continue it into fome ditch or low part in the lands below, that the water may be freely carried off, after it has been and while it is in ufe. Draw ditches above the field intended to be watered aflant the fides of the hill, in fuch a manner that they may all empty themfelves into the head of the ditch above mentioned, juft where it enters the field to be watered; then erecting a ware acrofs this ditch, the field will be capable of being watered, according to the fituation of the ditch in the middle or on the fide of the field. It muft then be conveyed by fmall mains or trenches, and fubdivided again by branch-trenches, according to the fite of the field and quantity of water that can be collected; trench-drains muft be drawn, and the water conveyed into the ditch by means of tail-drains. A perfon unacquainted with water-meadows cannot conceive the advantage arifing from water thus collected and conveyed over this fpecies of water-meadow (if it may be fo called), being generally a firm good foil; but the water running down from rich cultivated hills, eminences, &c. fweeps away with it, when the rain falls very heavy, vaft quantities of dung dropped by fheep and other cattle, and the manure carried upon arable lands; all which being now diverted, and carried over the meadow with an eafy defcent, gives time for the particles of manure to fubfide upon the ground at one feafon, or of being filtered from it as it dribbles through the grafs at another; after which the warm weather pufhes on vegetation amazingly. Meadows thus fituated would be vaftly fuperior to any other, if they had the advantage of a conftant ftream; but even as they are, taking the opportunity of watering them by every heavy rain or flood that happens, they will be found to be very valuable. The occupier of fuch lands is ftrenuoufly advifed to let no time be loft in appropriating them to this ufe; becaufe thefe lands are healthy for all kinds of cattle at almoft all feafons; and the expence of converting

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verting them into this kind of water-meadow is exceeding small, the annual charges afterwards quite trifling, and the produce very considerable."

438 Mr Wright's directions for watering through the different months of the year.

Mr Wright, having discussed the subject of the quality of the water, proceeds to give directions for watering through the different months of the year;—"In December and January, the chief care consists in keeping the land sheltered by the water from the severity of frosty nights. It is necessary, however, through the whole winter, every ten days or fortnight, to give the land air, by taking the water off entirely, otherwise it would rot and destroy the roots of the grass. It is necessary, likewise, that a proper person should go over every meadow at least twice every week, to see that the water is equally distributed, and to remove all obstructions arising from the continual influx of weeds, leaves, sticks, and the like. In February, a great deal depends upon care and caution. If you now suffer the water to remain on the meadow for many days without intermission, a white scum is raised, very destructive to the grass; and if you take off the water, and expose the land to a severe frosty night, without its being previously dried for a whole day, the greatest part of the tender grass will be cut off. The only ways to avoid both these injuries are, either to take the water off by day to prevent the scum, and to turn it over again at night to guard against the frost; or, if this practice be too troublesome, both may be prevented by taking the water entirely off for a few days and nights, provided the first day of taking off be a dry one; for if the grass experience one fine drying day, the frost at night can do little or no injury. The scum is generated chiefly by the warmth of the sun, when the water is thin and used too plentifully. Towards the middle of this month we vary our practice in watering, by using only about half the quantity of water which is made use of earlier in the winter, all that is now required being to keep the ground in a warm moist state, and to force vegetation.

"At the beginning of March, the crop of grass in the meadows is generally sufficient to afford an abundant pasturage for all kinds of stock, and the water is taken off for near a week, that the land may become dry and firm before the heavy cattle are turned in.—It is proper, the first week of eating off the spring-feed, if the season be cold, to give the cattle a little hay each night."

439 Of eating off the spring grass with ewes and lambs.

"It is a custom (says Mr Wright) with some farmers in Hampshire, to eat off the spring grass of their meadows with ewes and lambs, in the same manner that we do a field of turnips, by inclosing a certain portion each day with hurdles or stakes, and giving them hay at the same time. This is certainly making the most of the grass, and an excellent method to fine and sweeten the future herbage. In this month and April, you may eat the grass as short and close as you please, but never later; for if you trespass only one week on the month of May, the hay-crop will be very much impaired, the grass will become soft and woolly, and have more the appearance and quality of an after-math than a crop. At the beginning of May, or when the spring-feeding is finished, the water is again used for a few days by way of wetting.

440 How watering may occasion the rot in sheep.

"It is rather remarkable, that watering in autumn, winter, or spring, will not produce that kind of herbage which is the cause of the rot in sheep; but has been known to remove the cause from meadows, which before had that baneful effect. If, however, you use the water only a few days in any of the summer months; all the lands thus watered will be rendered unsafe for the pasturage of sheep. Of this I was lately convinced from an experiment made by a friend. At the beginning of July, when the hay was carried off, and the water rendered extremely muddy and abundant by several days rain, he thought proper to throw it over his meadows for ten days, in which time a large collection of extremely rich manure was made upon the land. In about a month the meadow was covered with uncommon luxuriancy and blackness of herbage. Into this grass were turned eight sound ewes and two lambs. In six weeks time the lambs were killed, and discovered strong symptoms of rottenness; and in about a month afterwards one of the ewes was killed, and though it proved very fat, the liver was putrid and replete with the insect called the *fluke* or *weevil:* the other ewes were sold to a butcher, and all proved unsound. This experiment, however, convinces me, by the very extraordinary improvement made thereby in the meadow, that muddy water in the summer is much more enriching than it is in autumn or winter; and ought, therefore, to be used for a week at least every wet summer, notwithstanding its inconveniences to sheep, the most profitable species of stock."

441 Mr Boswell's general directions for watering.

Mr Boswell, besides his general directions for watering, gives many plans of the ditches, drains, &c. for particular meadows, some of them done from an actual survey. But these being confined to particular situations, we shall here only speak of his method in general. In his third chapter, entitled *A general Description of Water-meadows*, he observes, that "lands capable of being watered, lie sometimes only on one side, and sometimes on both sides of the stream designed to supply them with water. In the former case, when they have a pretty quick descent, the land may be often watered by a main drawn out of the stream itself, without any ware;" though he acknowledges that it is by far the best way to erect a ware, and to draw mains on each side, to dispose of the water to the best advantage.

Boggy lands require more and longer continued watering than such as are sandy or gravelly; and the larger the body of water than can be brought upon them, the better. The weight and strength of the water will greatly assist in compressing the soil, and destroying the roots of the weeds that grow upon it; nor can the water be kept too long upon it, particularly in the winter season; and the closer it is fed, the better.

To improve strong clay soils, we must endeavour to the utmost to procure the greatest possible descent from the trench to the trench-drain; which is best done by making the trench-drains as deep as possible, and applying the materials drawn out of them to raise the trenches. Then, with a strong body of water, taking the advantage of the autumnal floods, and keeping the water some time upon them at that season, and as often as convenient during the winter, the greatest improvement on this sort of soils may be made. Warm sand or gravelly soil, are the most profitable under the watering system, provided the water can be brought over them at pleaſure. In ſoils of this kind, the water muſt not be kept long at a time, but often ſhifted, thoroughly drained, and the land frequently refreſhed with it: under which circumſtances the profit is immenſe. A ſpring-feeding, a crop of hay, and two after-maths, may be obtained in a year; and this, probably, where in a dry ſummer ſcarce graſs enough could be found to keep a ſheep alive. If the ſtream be large, almoſt any quantity of land may be watered from it; and though the expence of a ware over it is great, it will ſoon be repaid by the additional crop. If the ſtream is ſmall, the expence will be ſo in proportion.

442
Method of improving a ſpringy water meadow.

The following method of improving a water-meadow that was ſpringy has been tried by Mr Boſwell with ſucceſs. The meadow had been many years watered by a ſpring riſing juſt above it from a barren ſandy heath; the ſoil near the ſurface was in ſome places a gravelly land, in others a ſpongy cork, both upon a ſtrong clay and ſand mixture, which retained the draining of the lands above it. Whenever it had been watered, and left to drain itſelf dry, a yellowiſh red water ſtood in many parts, and oozed out of others; the herbage being no other than a poor, miſerable, hairy graſs and ſmall ſedge. Chalk and aſhes had been thrown over it to very little purpoſe. It was then drained underground aſlant all the different deſcents, and all theſe drains carried into one large drain, which had been already cut for the purpoſe of carrying off the water when the meadow was overflowed. Theſe drains were cut quite through the mixture of clay and ſand, and as much deeper as the fall of the ground below would admit of; then, with chalk cut for the purpoſe, ſmall hollow drains were formed at the bottom of theſe; the drains were then filled up with the materials that came out.

This was done in the beginning of ſummer, and the work frequently examined through the ſeaſon; the ſoil was found firmer than before, and none of that naſty red water to be met with upon the ſurface, though it continually oozed into the drains. In autumn the meadow was again prepared for waterings, by repairing thoſe trenches and drains that were properly ſituated; and by cutting others where wanted, for the purpoſe of watering the meadow. The water being then brought over it from the ſame ſpring as before, the event anſwered the moſt ſanguine wiſhes of the proprietor; the effects were viſible the firſt year, and the ground has been conſtantly improving ever ſince.

443
Of watering lands on the ſides of hills.

Mr Boſwell alſo informs us, that a gentleman in Scotland had applied to him for directions to water ſome lands lying on the ſides of hills, where the deſcent is quick; and of which there are many in this country, as well as in the north of England. It would be difficult to water ſuch lands by means of drains and trenches according to the directions already given; becauſe the bends in the trenches muſt be very near together and large, as the water muſt flow out of the trench *above* the bend to flow over the pane below it; the number and ſize would likewiſe be inconvenient, and greatly offend the eye.

Lands of this ſort are generally capable of being ploughed; in which caſe our author directs them to be once ploughed in the ſpring, and ſown with oats or any other kind of grain that will rot the ſward. When the grain is harveſted, plough the land acroſs; the laſt ploughing with the Kentiſh plough, which has a moveable mouldboard, and is called a *turn-wriſt* plough. This turns the furrows down the ſide of the hill, the horſes going forwards and backwards in the ſame furrows. By this means the land is laid flat without any open furrows in it: dreſs it down in the ſpring very fine, and ſow it with oats, and mix with ſome kinds of graſs ſeeds very thick. Thus the ground will have but few irregularities; and as ſoon as the corn is carried off, or the following ſpring at fartheſt, the mains and drains may be cut out.

For watering coarſe lands that are firm enough to bear the plough, and ſituated near a ſtream, our author gives the following directions.

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Of watering coarſe lands.

"Let the land thus ſituated be ploughed once in the ſpring, and ſown with any grain that will rot ſward. As ſoon as the crop is off, plough it again, and leave it rough through the winter. Work it down early in the ſpring, and plough it in the direction the trenches are to lie, making the ridges of a proper ſize for watering, ten or twelve yards wide for inſtance; work it fine; then gather the ridges up again in the ſame manner, making the laſt furrows of each ridge as deep as poſſible. If the land be not fine, dreſs it down again, and gather it up a ſecond time if neceſſary; and with a ſhovel throw the earth from the edges of the furrows to the tops of the ridges, to give the greateſt poſſible deſcent from the trench to the drain. Sow it with oats and graſs ſeeds very thick; and after the corn is carried off, the trenches may be formed upon the top of each ridge, diſperſing the furrows with a ſpade as much as the fall of the land will admit of for the drains; taking care to procure ſufficient fall at all events, to drain the lands after they have been watered. By this method the crop of corn will nearly pay all the expence, and the land will be in excellent order."

445
Of the management of meadows after watering.

After the work of watering a meadow is totally finiſhed, and the hay carried off, cattle may be let in to eat the after-math. When this is done, it will then be neceſſary to examine whether or not the mains have ſuffered any injury from their feet; whether there be quantities of mud or ſand collected at the angles, &c. all of which muſt be thrown out and the breaches repaired; by which means the trenches, drains, &c. will laſt three years, but otherwiſe not more than two. The roots, mud, &c. may be uſed in repairing the breaches, but never left upon the ſides of the trenches out of which they are taken. The tail-drains require to be cleanſed oftener than any of the other works, for this obvious reaſon, that the mud, &c. is carried down from all the others into them; where, if it be allowed to accumulate, it occaſions a ſtagnation of water upon the meadow itſelf. In repairing the trenches, particular care ought to be taken that the workmen do not make them any wider than before, which they are very apt to do; neither are they to be allowed to throw the materials which they dig out in a ridge behind the edge of the trench, which both widens it and promotes weeds.

446
Of the times the water ſhould continue upon the meadows.

During the time of watering, it will be neceſſary to examine the meadow every two or three days in order to remove obſtructions, &c. If the drains ſhould be filled with water and run over, they ought to be made deeper; or if this cannot be done, they ſhould be widened

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widened. In the winter time a regular ftrong water fhould be kept, avoiding very ftrong great floods. In this feafon the water may be kept on the ground with fafety for a month or even fix weeks, if the foil be corky or boggy, or a ftrong clay; but not quite fo long if it be gravel or fand. At the fecond watering a fortnight or three weeks will be fufficient; and after Candlemas a fortnight will be rather too long. At the third watering a week will be fufficient, which will bring it to about the middle of March; by which time, if the weather be tolerably mild, the grafs will be long enough for the ewes and lambs, or fatting lambs; which may then be turned into the meadow with great advantage. Even in the end of February, if the winter has been very mild, the grafs will be long enough for them. Here they may be permitted to feed till the beginning of May, changing them into different meadows. As foon as they are taken out, the water muft be turned in for a week, carefully examining every trench and drain for the reafons already given. The water is then to be fhifted into others, alternately watering and draining, leffening the time the water remains upon it as the weather grows warmer; and in five, fix, or feven weeks, the grafs will be fit to be mown for hay, and produce from one to two tons, or even more, an acre upon good ground.

Mr Bofwell directs, that about a week before the grafs is to be mown, the water fhould be let into the meadow for 24 hours; which, he fays, will make the ground moift at the bottom, the fcythe will go through it the more eafily, and the grafs will be mown clofer to the ground. This practice, however, is entirely difapproved of by Mr Wright. "Though it may prevail in Dorfetfhire (fays he), it is very feldom advifable, for the following reafons: Water made to run through a thick crop of grafs, though it may appear ever fo pure, will leave a certain quantity of adherent fcum or fediment, which can never be feparated from the hay, but will render it unpalatable, if not prejudicial, to the cattle that eat it. And this wetting of the land and grafs will impede the drying or making of the hay perhaps fome days, which in difficult feafons is of very great confequence, and it will likewife make the turf too foft and tender to fupport the wheels of a loaded waggon in carrying off the hay. Befides, there is reafon to believe that one day's wetting in the fummer, will, upon moft meadows, endanger the foundnefs of every fheep that feeds upon the aftermath."

447 Of fpring-feeding.

The fpring-feeding ought never to be done by heavier cattle than fheep or calves; for large cattle do much hurt by poaching the ground with their feet, deftroying the trenches, and fpoiling the grafs. Mr Bofwell likewife greatly recommends a proper ufe of fpring floods, from which he fays much benefit may be derived; but, if there is any quantity of grafs in the meadows not eaten, thefe floods muft be kept out; otherwife the grafs will be fpoiled; for they bring with them fuch quantities of fand and mud, which ftick to the grafs, that the cattle will rather ftarve than tafte it. Great quantities of grafs or after-math are frequently fpoiled in flat countries by the floods which take place in the fall. In the winter time, however, when the ground is bare, the fand and mud brought down by the floods is foon incorporated with the foil, and becomes an excellent manure. The certain rule with regard to this matter is, "Make ufe of the floods when the grafs cannot be ufed; avoid them when the grafs is long or foon to be cut."

448 Of watering from the end of autumn to Candlemas.

"It has often been a fubject of difpute (fays Mr Bofwell), whether, from the latter end of autumn to Candlemas, the throwing a very ftrong body of water, where it can be done, over the meadows, is of any effential fervice or not? Thofe who confider it as advantageous, affert, that when the waters run rude and ftrong over the ground, they beat down and rot the tufts of foggy or rough grafs, fedges, &c. that are always to be found in many parts of coarfe meadow-ground; and therefore are of peculiar fervice to them. On the other fide it is alledged, that by coming in fo large a body, it beats the ground (in the weak places particularly) fo bare, that the fward is deftroyed; and alfo brings with it fuch quantities of feeds of weeds, that at the next hay feafon the land in all thofe bare places bears a large burden of weeds, but little grafs.

"The general opinion of the watermen upon this point is, that in water-meadows which are upon a warm, fandy, or gravelly foil, with no great depth of loam upon them, rude ftrong watering, even in winter, always does harm without any poffible effential fervice. On the contrary, cold ftrong clay land will bear a great deal of water a long time without injury; and boggy, corky, or fpongy foil, will alfo admit of a very large and ftrong body of water upon it with great advantage for almoft any length of time at that feafon, provided the drains are made wide and deep enough to carry it off, with out forcing back upon the end of the panes. The weight and force of the water vaftly affifts in compreffing thofe foils, which only want folidity and tenacity to make them produce great burdens of hay: nothing, in their opinion, corrects and improves thofe foils fo much as a very ftrong body of water, kept a confiderable time upon them at that feafon."

Notwithftanding the above reafons, however, Mr Bofwell informs us, that he has doubts upon the fubject; nor can he by any means acquiefce in this opinion, unlefs, by rude ftrong waters he is permitted to underftand only rather a larger quantity of water conveyed over the land at this early feafon than ought to be ufed in the fpring or fummer: unmanageable waters he believes always hurtful.

"It may be proper juft to add (continues he), that as foon as the hay is carried off the meadows, cattle of any fort except fheep may be put to eat the grafs out of the trenches, and what may be left by the mowers. This perhaps will laft them a week; when the water may be put into the meadows in the manner already defcribed, taking care to mow the long grafs which obftructs the water in the trenches; and this mowing is beft done when the water is in them. Let the weeds, leaves, &c. be taken out and put in heaps, to be carried away into the farm yards; examine the trenches, make up the breaches, &c. take particular care that the water only dribbles over every part of the panes as thin as poffible, this being the warmeft feafon of the year. The firft watering fhould not be fuffered to laft longer than two or three days before it is fhifted off (and if the feafon be wet, perhaps not fo long, as

warmth

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warmth feems to be the greateft requifite after the land is once wet to affift vegetation) to another part or meadow beat out by the cattle, by this time fit to take it. Do by this meadow exactly the fame, and fo by a third and fourth, if as many meadows belong to the occupier. Obferve at all times, when the water is taken out of a meadow, to draw up the drain-fluice hatches; as, without doing that, watering is an injury. By the time that three or four parts are thus regularly watered, the firft will have an after-math, with fuch rich and beautiful verdure as will be aftonifhing; and both quantity and quality will be beyond conception better than if the lands had not been watered.

"Hence we fee why every perfon fhould, if poffible, have three or four meadows that can be watered; for here, while the cattle are eating the firft, the fecond is growing, the third draining, &c. and the fourth under water. In this manner the after-math will in a mild feafon laft till Chriftmas. A reafon was given why the fpring-grafs fhould be fed only by fheep or calves; a reafon equally cogent may be given, why the after-grafs ought not to be fed by them, becaufe it will infallibly rot them. No fheep (fays our author), except thofe which are juft fat, muft ever be fuffered even for an hour in water-meadows except in the fpring of the year; and even then care muft be taken that every part of the meadows have been well watered, and that they are not longer kept in them than the beginning of May. Although at prefent it is unknown what is the occafion of the rot, yet certain it is, that even half an hour's feeding in unhealthy ground has often proved fatal. After a fhort time they begin to lofe their flefh, grow weaker and weaker; the beft feeding in the kingdom cannot improve them after they once fall away; and when they die, animalcula like plaice are found in the livers. Scarcely any ever recover from a flight attack; but when farther advanced, it is always fatal. Guard by all means againft keeping the water too long upon the meadow in warm weather; it will very foon produce a white fubftance like cream, which is prejudicial to the grafs, and fhows that it has been too long upon the ground already. If it be permitted to remain a little longer, a thick fcum will fettle upon the grafs of the confiftence of glue, and as tough as leather, which will quite deftroy it wherever it is fuffered to be produced. The fame bad effects feem to arife from rude waters; neither can the fcum eafily be got off.

449 Water ought not to be kept too long upon meadows.

450 Advantages of rolling meadows.

"Rolling meadows in the fpring of the year is an excellent method. It fhould be done after Candlemas, when the meadow has been laid dry a week. It fhould be always rolled lengthwife of the panes, up one fide of the trench and down the other. Rolling alfo contributes much to the grafs being cut clofe to the furface when mown, which is no fmall advantage; for the little hillocks, fpewings of worms, ant-hills, &c. are by this means preffed clofe to the ground, which would otherwife obftruct the fcythe and take off its edge; and to avoid that inconvenience, the workmen always mow over them."

As a water-meadow has with fo much juftice been called a *hot-bed of grafs*, and as the practice of flooding tends fo completely to ameliorate the pooreft foils, and to extirpate heath and all coarfe and woody plants, we are fatisfied that the knowledge of it cannot be too extenfively diffufed, or too minutely enquired into. That it may be more clearly underftood, therefore, we fhall here give a ftatement of the mode in which it is practifed in Gloucefterfhire, as explained from Mr Wright's pamphlet, by the Rev. Mr Charles Finlater, in a letter to the conductors of the Farmer's Magazine.

451 Watering explained by Mr Finlater.

"Fig. 6. reprefents a float-meadow under irrigation; the dark fhading reprefenting the water.

Plate XII.

"When the hatch of the water dam-dike (marked H) is lifted up, the water runs in the natural channel of the river; when the hatch is fhut, as reprefented in the figures, the natural channel is laid dry below it, and the water runs laterally along the main-feeder, in the direction of the arrows, and is from it diftributed into the floating-gutters (*g, g, g, g*), which are formed along the crowns of the ridges, into which the meadow is arranged, overflowing on both fides of faid gutters, and running down the fides of the ridges into the furrows or drains betwixt the ridges (*d, d, d, d*), which drains difcharge it into the main-drain, whereby it is returned into its natural channel at the foot of the meadow.

"The marks (○ ○, or Δ Δ), and the tufts, in the main-feeder and the floating-gutters, denote—The firft, obftructions (made by fmall ftakes, or fods, or ftones) to raife the water, and make it flow over from the main-feeder into the floating-gutters, or from the latter over the fides of the ridges; the fecond, nicks, made in their fides, with a fimilar intention. If, however, the main-feeder and floating-gutters are properly conftructed at their firft formation, thefe fupplementary aids will be, in a great meafure, unneceffary: For the main-feeder ought, at its entrance, to be of dimenfions juft fufficient to admit the quantity of water which is to be conveyed to the meadow; and gradually to contract its fize as it goes along, in order that the water, for want of room, may be forced over its fide, and into the floating-gutters: thefe laft ought to be formed after the fame model, that the water may, by their primary conftruction, overflow their fides, through their whole courfe. That as little as poffible of the furface may be unproductive, a fimilar conftruction fhould be adopted for the drains; they ought to be narrow neareft to the main-feeder, where they receive little water, and to diverge as they approach the main-drain; which laft is, for the fame reafon, fimilarly conftructed. In the plan, this mode of conftruction is made obvious to the eye.

"The meadow, in this plate, muft be conceived to lie in a regular and very gentle flope from the main-feeder to the main-drain.

"Fig. 4. and fig. 5. prefent a view of the ridges cut acrofs, with the feeding-gutter (*g*) upon their crown, and the furrows, or difcharging drains (*d, d*) along their fides. Fig. 5. fhows the fhape (of gradual flope) into which they ought to be formed at firft, were it not for the expence, *i. e.* when they are to be formed out of grafs fields, preferving the grafs fward. Fig. 4. reprefents the mode in which they may, more cheaply, though more roughly, be formed at firft; when, the depofitions of fediment from the floating water, will gradually fill the fhoulders of the floating-gutters, up to the dotted line, forming the ridge into the fhape of fig. 5.

"In the formation of the meadow, (particularly if the declivity is very fmall), care fhould be taken to lofe as little as poffible of the level in the main-feeder, and in the

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the floating-gutters; in order that the greater defcent may be given to the water down the fides of the ridges, from the floating-gutters to their difcharging drains, that the water may float over the ridges fides with the more rapidity, and in the more quick fucceffion.

"The diftance from the floating-gutter to the difcharging-drain, ought not to be lefs than four yards, *i. e.* the breadth of the ridge eight yards; nor more than five yards and a half, *i. e.* the breadth of the ridge eleven yards.

"It is evident from the plan, that, when the hatch (H) is lifted up, the water refumes its natural channel, and the meadow becomes at once dry. Its figure frees it inftantly of all furface water. If any of it is wet from fprings, thefe muft be carried off by under-draining; for it muft be thoroughly drained before you can drown it to good effect.

Fig. 7. "This figure reprefents a float-meadow, where the declivity is unequal, and which, alfo, is too large, for the command of water, to admit of being floated all at once.

"In this meadow, it is fuppofed that the ground rifes, from the natural channel of the river, up to (F 1.), which is a feeder, with its floating-gutters (*g, g, g, g*); and thence defcends to the hollow (D 1.), which is a drain communicating with the main-drain, and receiving the water from the leffer drains or receiving furrows (*d, d, d*). It is fuppofed, that the ground rifes again from the hollow (D 1.), up to the fecond feeder (F 2.); and thence defcends again into the hollow, along which is conducted the receiving-drain (D 2.) The remainder of the meadow is fuppofed to lie in a regular flope, from the main-feeder to the drain laft mentioned, and the main-drain. The letter (*r*) marks a very fmall rut, made with a fpade, or triangular hoe, for conducting water to places upon which it appears not to fcatter regularly.

"The hatch upon the river's natural channel, and that upon the feeder (F 2.) are reprefented as fhut; and, confequently the natural channel, together with that part of the meadow which is floated from the feeder (F 2.), as dry. The hatches upon the feeder (F 1.), and upon the main-feeder, are reprefented as drawn up; and, confequently the two parts of the meadow, floated from them, are reprefented as under water.

Fig. 8. "This reprefents catch-meadow, for a fteep declivity, or fide of a hill. It is called *catch*, becaufe, when the whole is watered at once, the water floating over the uppermoft pitches is catched in the floating-gutters, which diftribute the water over the inferior pitches.

"The lateral horizontal feeding-gutters, which fcatter the water over the firft and fecond pitches, are reprefented as fhut by fods or ftones, &c. (8); and confequently thefe firft and fecond pitches appear dry: The whole water is reprefented as paffing down the main-feeder into the loweft floating-gutter, whence it floats the loweft or third pitch; and is received into the drain at the foot of the meadow, to be returned by it into the natural channel.

"When the whole is to be floated at once, the obftructions (8) are taken from the lateral floating-gutters: obftructions, mean time, are placed in the main-feeder, immediately under the floating-gutters, to force the water into faid gutters.

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"N. B. In obftructing the main-feeder, care muft be taken not to obftruct it entirely, but to allow always a part of the water it contains to efcape in it to the lower pitches; for, fuppofing the main-feeder to be entirely fhut under the feeding-gutter (*g* 1.); fo that the whole water was made to run over the firft pitch, from faid gutter and the horizontal part of the main-drain, the water filtrated through the grafs of the firft pitch, would be fo very much deprived of its fertilizing qualities, as to be incapable of communicating almoft any perceptible benefit to the pitches lying below. Water fo filtrated, is called technically *ufed water*; and is efteemed next to ufelefs; and for this reafon, the grafs neareft the floating-gutters is moft abundant, and of beft quality, in all kinds of meadow.

"The proper breadth of the pitches of catch-meadow, from gutter to gutter, does not feem well determined; they ought, probably, not to be much broader than the diftance from the floating-gutter to the receiving-drain in float-meadow, *i. e.* from four to five or fix yards.—Catch-meadow is not fo much prized as float-meadow.

"In the conftruction of the float-meadows, the floating gutters die away to nothing before they meet the main-drain; the water from the end of the gutter finding its way over the intervening fpace, or being affifted in fcattering by fmall ruts marked (*r*). The receiving-drains fhould, for like reafon, not be commenced till within half a ridge breadth of the main-feeder."

It is to be obferved with regard to the laft of thefe modes of flooding, called *catch-meadow*, that although lands thus watered do not become equal to more level grounds fubjected to the fame procefs, or float-meadow, yet that the improvement of them is perhaps greater in proportion to the value of the lands in their original ftate; for, in this way, lands upon the declivity of hills, which once produced next to nothing, are enabled to bear a confiderable crop of valuable grafs. As ftreams of water are in high countries frequently found defcending from very lofty fituations, and as in thefe cafes the expence of forming *catch-meadow* is very trifling, it may be regarded as of the moft extenfive utility.

Sect. V. *Rotation of Crops.*

No branch of hufbandry requires more fkill and fagacity than a proper rotation of crops, fo as to keep the ground always in heart, and yet to draw out of it the greateft profit poffible. Some plants rob the foil, others are gentle to it: fome bind, others loofen. The nice point is, to intermix crops, fo as to make the greateft profit confiftently with keeping the ground in trim. In that view, the nature of the plants employed in hufbandry muft be accurately examined. 452 Rotation of crops.

The difference between culmiferous and leguminous plants, is occafionally mentioned above. With refpect to the prefent fubject, a clofer infpection is neceffary. Culmiferous plants, having fmall leaves and few in number, depend moftly on the foil for nourifhment and little on the air. During the ripening of the feed, they draw probably their whole nourifhment from the foil; as the leaves by this time, being dry and withered, muft have loft their power of drawing nourifhment from the air. Now, as culmiferous plants are chiefly cultivated for their feed, and are not cut down till the 453 Culmiferous and leguminous plants.

feed

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feed be fully ripe, they may be pronounced all of them to be robbers, fome more, fome lefs. But fuch plants, while young, are all leaves; and in that ftate draw moft of their nourifhment from the air. Hence it is, that where cut green for food to cattle, a culmiferous crop is far from being a robber. A hay-crop accordingly, even where it confifts moftly of rye-grafs, is not a robber, provided it be cut before the feed is formed; which at any rate it ought to be, if one would have hay in perfection. And the foggage, excluding the froft by covering the ground, keeps the roots warm. A leguminous plant, by its broad leaves, draws much of its nourifhment from the air. A cabbage which has very broad leaves, and a multitude of them, owes its growth more to the air than to the foil. One fact is certain, that a cabbage cut and hung up in a damp place, preferves its verdure longer than other plants. At the fame time, a feed is that part of a plant which requires the moft nourifhment; and for that nourifhment a culmiferous plant muft be indebted entirely to the foil. A leguminous crop, on the contrary, when cut green for food, muft be very gentle to the ground. Peafe and beans are leguminous plants; but being cultivated for feed, they feem to occupy a middle ftation: their feed makes them more fevere than other leguminous crops cut green; their leaves, which grow till reaping, make them lefs fevere than a culmiferous plant left to ripen.

Thefe plants are diftinguifhed no lefs remarkably by the following circumftance. All the feeds of a culmiferous plant ripen at the fame time. As foon as they begin to form, the plant becomes ftationary, the leaves wither, the roots ceafe to pufh, and the plant, when cut down, is blanched and faplefs. The feeds of a leguminous plant are formed fucceffively: flowers and fruit appear at the fame time in different parts of the plant. This plant accordingly is continually growing, and pufhing its roots. Hence the value of bean or peafe ftraw above that of wheat or oats: the latter is withered and dry when the crop is cut; the former, green and fucculent. The difference therefore, with refpect to the foil, between a culmiferous and leguminous crop, is great. The latter, growing till cut down, keeps the ground in conftant motion, and leaves it to the plough loofe and mellow. The former gives over growing long before reaping; and the ground, by want of motion, turns compact and hard. Nor is this all. Dew falling on a culmiferous crop after the ground begins to harden, refts on the furface, and is fucked up by the next fun. Dew that falls on a leguminous crop, is fhaded from the fun by the broad leaves, and finks at leifure into the ground. The ground accordingly, after a culmiferous crop, is not only hard, but dry: after a leguminous crop, it is not only loofe, but foft and unctuous.

Of all culmiferous plants, wheat is the moft fevere, by the long time it occupies the ground without admitting a plough. And as the grain is heavier than that of barley or oats, it probably requires more nourifhment than either. It is obferved above, that as peafe and beans draw part of their nourifhment from the air by their green leaves while allowed to ftand, they draw the lefs from the ground; and by their conftant growing they leave it in good condition for fubfequent crops. In both refpects they are preferable to any culmiferous crop.

Culmiferous crops, as obferved above, are not robbers when cut green: the foil, far from hardening, is kept in conftant motion by the pufhing of the roots, and is left more tender than if it had been left at reft without any bearing crop.

Bulbous-rooted plants are above all fuccefsful in dividing and pulverizing the foil. Potato-roots grow fix, eight, or ten inches under the furface; and, by their fize and number, they divide and pulverize the foil better than can be done by the plough; confequently, whatever be the natural colour of the foil, it is black when a potato-crop is taken up. The potato, however, with refpect to its quality of dividing the foil, muft yield to a carrot or parfnip; which are large roots, and pierce often to the depth of 18 inches. The turnip, by its tap-root, divides the foil more than can be done by a fibrous-rooted plant; but as its bulbous-root grows moftly above ground, it divides the foil lefs than the potato, the carrot, or the parfnip. Red clover, in that refpect, may be put in the fame clafs with turnip.

Whether potatoes or turnip be the more gentle crop, appears a puzzling queftion. The former bears feed, and probably draws more nourifhment from the foil than the latter, when cut green. On the other hand, potatoes divide the foil more than turnip, and leave it more loofe and friable. It appears no lefs puzzling, to determine between cabbage and turnip: the former draws more of its nourifhment from the air, the latter leaves the foil more free and open.

The refult of the whole is what follows: Culmiferous plants are robbers; fome more, fome lefs: they at the fame time bind the foil; fome more, fome lefs. Leguminous plants in both refpects are oppofite: if any of them rob the foil, it is in a very flight degree; and all of them without exception loofen the foil. A culmiferous crop, however, is generally the more profitable: but few foils can long bear the burden of fuch crops, unlefs relieved by interjected leguminous crops. Thefe, on the other hand, without a mixture of culmiferous crops, would foon render the foil too loofe.

Thefe preliminaries will carry the farmer fome length in directing a proper rotation of crops. Where dung, lime, or other manure, can be procured in plenty to recruit the foil after fevere cropping, no rotation is more proper or profitable in a ftrong foil, than wheat, peafe or beans, barley, oats, fallow. The whole farm may be brought under this rotation, except fo far as hay is wanted. But as fuch command of manure is rare, it is of more importance to determine what fhould be the rotation when no manure can be procured but the dung collected in the farm. Confidering that culmiferous crops are the more profitable in rich land, it would be proper to make them more frequent than the other kind. But as there are few foils in Scotland that will admit fuch frequent culmiferous crops without fuffering, it may be laid down as a general rule, that alternate crops, culmiferous and leguminous, ought to form the rotation. Nor are there many foils that will ftand good, even with this favourable rotation, unlefs relieved from time to time by pafturing a few years. If fuch extended rotation be artfully carried on,

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on, crops without end may be obtained in a tolerable good soil, without any manure but what is produced in the farm.

454 The nature of soil considered, with regard to the rotation of crops.

It is scarce necessary to be mentioned, being known to every farmer, that clay answers best for wheat, moist clay for beans, loam for barley and pease, light soil for turnip, sandy soil for rye and buck-wheat; and that oats thrive better in coarse soil than any other grain. Now, in directing a rotation, it is not sufficient that a culmiferous crop be always succeeded by leguminous: attention must also be given, that no crop be introduced that is unfit for the soil. Wheat, being a great binder, requires more than any other crop a leguminous crop to follow. But every such crop is not proper: potatoes are the greatest openers of soil; but they are improper in a wheat soil. Neither will turnip answer, because it requires a light soil. A very loose soil, after a crop of rye, requires rye-grass to bind it, or the treading of cattle in pasturing: but to bind the soil, wheat must not be ventured; for it succeeds ill in loose soil.

Another consideration of moment in directing the rotation is, to avoid crops that encourage weeds. Pease is the fittest of all crops for succeeding to wheat, because it renders the grounds loose and mellow, and the same soil agrees with both. But beware of pease, unless the soil be left by the wheat perfectly free of weeds; because pease, if not an extraordinary crop, foster weeds. Barley may be ventured after wheat, if the farmer be unwilling to lose a crop. It is indeed a robber; better, however, any crop, than run the hazard of poisoning the soil with weeds. But to prevent the necessity of barley after wheat, the land ought to be fallowed before the wheat: it cleans the ground thoroughly, and makes pease a secure crop after wheat. And after a good crop of pease, barley never fails. A horse-hoed crop of turnip is equal to a fallow for rooting out weeds; but turnip does not suit land that is proper for wheat. Cabbage does well in wheat soil; and a horse-hoed crop of cabbage, which eradicates weeds, is a good preparation for wheat to be succeeded by pease; and a crop of beans diligently hand-hoed, is in that view little inferior. As red clover requires the ground to be perfectly clean, a good crop of it insures wheat, and next pease. In loam, a drilled crop of turnip or potatoes prepares the ground, equal to a fallow, for the same succession.

Another rule is, to avoid a frequent repetition of the same species; for to produce good crops, change of species is no less necessary than change of seed. The same species returning every second or third year, will infallibly degenerate, and be a scanty crop. This is remarkably the case of red clover. Nor will our fields bear pleasantly perpetual crops of wheat after fallow, which is the practice of some English farmers.

Hitherto of rotation in the same field. We add one rule concerning rotation in different fields; which is, to avoid crowding crops one after another in point of time; but to choose such as admit intervals sufficient for leisurely dressing, which gives opportunity to manage all with the same hands, and with the same cattle; for example, beans in January or February, pease and oats in March, barley and potatoes in April, turnip in June or July, wheat and rye in October.

For illustrating the foregoing rules, a few instances of exceptionable rotations will not be thought amiss. The following is an usual rotation in Norfolk. First, wheat after red clover. Second, barley. Third, turnip. Fourth, barley with red clover. Fifth, clover cut for hay. Sixth, a second year's crop of clover commonly pastured. Dung is given to the wheat and turnip.—Against this rotation several objections lie. Barley after wheat is improper. The two crops of barley are too near together. The second crop of clover must be very bad, if pasturing be the best way of consuming it; and if bad, it is a great encourager of weeds. But the strongest objection is, that red clover repeated so frequently in the same field cannot fail to degenerate; and of this the Norfolk farmers begin to be sensible. Salton in East Lothian is a clay soil; and the rotation there usually has been wheat after fallow and dung. Second, barley after two ploughings; the one before winter, the other immediately before the seed is sown. Third, oats. Fourth, pease. Fifth, barley. Sixth, oats; and then fallow. This rotation consists chiefly of robbing crops. Pease are the only leguminous crop, which, even with the fallow, is not sufficient to loosen a stiff soil. But the soil is good, which in some measure hides the badness of the rotation. About Seaton, and all the way from Preston to Gosford, the ground is still more severely handled: wheat after fallow and dung, barley oats, pease, wheat, barley, oats, and then another fallow. The soil is excellent; and it ought indeed to be so, to support many rounds of such cropping.

455 Exceptionable rotations.

In the parishes of Tranent, Aberlady, Dirleton, North-Berwick, and Athelstonefoord, the following rotations were formerly universal, and to this day are much more frequent than any other mode.

1. After fallow and dung, wheat, barley, oats, pease and beans, barley, oats, wheat.

2. After fallow and dung, barley, oats, pease and beans, wheat, barley, oats, pease, wheat.

3. After fallow and dung, wheat, oats, pease, barley, oats, wheat.

4. After fallow and dung, barley, oats, beans, wheat, pease, barley, oats.

In the several Tours that are published by Young, are found, in the best counties of England, examples without end, of rotations no less exceptionable than many of those mentioned.

456 Fields not to be kept too long in pasture.

Where a field is laid down for pasture in order to be recruited, it is commonly left in that state many years; for it is the universal opinion, that the longer it lies, the richer it becomes for bearing corn. This may be true; but in order to determine the mode of cropping, the important point is, what upon the whole is the most profitable rotation; not what may produce luxuriant crops at a distant period. Upon that point, it may be affirmed, that the farmer who keeps a field in pasture beyond a certain time, loses every year considerably; and that a few luxuriant crops of corn, after 20 years of pasture, and still more after 30, will not make up the loss.

Pasture-grass, while young, maintains many animals; and the field is greatly recruited by what they drop; it is even recruited by hay crops, provided the grass be cut before seeding. But as old grass yields little profit, the field ought to be taken up for corn when the pasture begins to fail; and after a few crops, it ought to

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to be laid down again with grafs feeds. Seduced by a chimerical notion, that a field, by frequent corn crops, is fatigued, and requires reft like a labouring man or animal, careful farmers give long reft to their fields by pafture, never adverting that it affords little profit. It ought to be their ftudy, to improve their foil, by making it free, and alfo retentive of moifture. If they accomplifh thefe ends, they need not be afraid of exhaufting the foil by cropping.

457 Examples of rotations.

Where a farmer has accefs to no manure but what is his own production, the cafe under confideration, there are various rotations of crops, all of them good, though perhaps not equally fo. We fhall begin with two examples, one in clay and one in free foil, each of the farms 90 acres. Six acres are to be inclofed for a kitchen garden, in which there muft be annually a crop of red clover, for fummer food to the working cattle. As there are annually 12 acres in hay, and 12 in pafture, a fingle plough with good cattle will be fufficient to command the remaining 60 acres.

Rotation in a clay foil.

Inclof.	1795.	1796.	1797.	1798.	1799.	1800.
1.	Fallow.	Wheat.	Peafe.	Barley.	Hay.	Oats.
2.	Wheat.	Peafe.	Barley.	Hay.	Oats.	Fallow.
3.	Peafe.	Barley.	Hay.	Oats.	Fallow.	Wheat.
4.	Barley.	Hay.	Oats.	Fallow.	Wheat.	Peafe.
5.	Hay.	Oats.	Fallow.	Wheat.	Peafe.	Barley.
6.	Oats.	Fallow.	Wheat.	Peafe.	Barley.	Hay.
7.	Pafture.	Pafture.	Pafture.	Pafture.	Pafture.	Pafture.

When the rotation is completed, the feventh inclofure, having been fix years in pafture, is ready to be taken up for a rotation of crops which begins with oats in the year 1801, and proceeds as in the fixth inclofure. In the fame year 1801 the fifth inclofure is made pafture, for which it is prepared by fowing pafture-grafs feeds with the barley of the year 1800. And in this manner may the rotation be carried on without end. Here the labour is equally diftributed; and there is no hurry nor confufion. But the chief property of this rotation is, that two culmiferous or white-corn crops are never found together; by a due mixture of crops, the foil is preferved in good heart without any adventitious manure. At the fame time, the land is always producing plentiful crops: neither hay nor pafture get time to degenerate. The whole dung is laid upon the fallow.

Every farm that takes a grafs crop into the rotation muft be inclofed, which is peculiarly neceffary in a clay foil, as nothing is more hurtful to clay than poaching.

Rotation in a free foil.

Inclof.	1795.	1796.	1797.	1798.	1799.	1800.
1.	Turnip.	Barley.	Hay.	Oats.	Fallow.	Wheat.
2.	Barley.	Hay.	Oats.	Fallow.	Wheat.	Turnip.
3.	Hay.	Oats.	Fallow.	Wheat.	Turnip.	Barley.
4.	Oats.	Fallow.	Wheat.	Turnip.	Barley.	Hay.
5.	Fallow.	Wheat.	Turnip.	Barley.	Hay.	Oats.
6.	Wheat.	Turnip.	Barley.	Hay.	Oats.	Fallow.
7.	Pafture.	Pafture.	Pafture.	Pafture.	Pafture.	Pafture.

For the next rotation, the feventh inclofure is taken up for corn, beginning with an oat crop, and proceeding in the order of the fourth inclofure; in place of which, the third inclofure is laid down for pafture by fowing pafture-graffes with the laft crop in that inclofure, being barley. This rotation has all the advantages of the former. Here the dung is employed on the turnip crop. Rotation of Crops.

We proceed to confider what rotation is proper for carfe clay. The farm we propofe confifts of 73 acres. Nine are to be inclofed for a kitchen garden, affording plenty of red clover to be cut green for the farm cattle. The remaining 64 acres are divided into four inclofures, 16 acres each, to be cropped as in the following table.

Inclof.	1 95.	1796.	1797.	1798.
1.	Beans.	Barley.	Hay.	Oats.
2.	Barley.	Hay.	Oats.	Beans.
3.	Hay.	Oats.	Beans.	Barley.
4.	Oats.	Beans.	Barley.	Hay.

Here the dung ought to be applied to the barley.

Many other rotations may be contrived, keeping to the rules above laid down. Fallow, for example, wheat, peafe and beans, barley, cabbage, oats, for clay. Here dung muft be given both to the wheat and cabbage. For free foil, drilled turnip, barley, red clover, wheat upon a fingle furrow, drilled potatoes, oats. Both the turnip and potatoes muft have dung. Another for free foil: turnip drilled and dunged, red clover, wheat on a fingle furrow with dung, peafe, barley, potatoes, oats. The following rotation has proved fuccefsful in a foil proper for wheat. 1. Oats with red clover, after fallow without dung. 2. Hay. The clover ftubble dunged, and wheat fown the end of October with a fingle furrow. 3. Wheat. 4. Peafe. 5. Barley. Fallow again. Oats are taken the firft crop, to fave the dung for the wheat. Oats always thrive on a fallow, though without dung, which is not the cafe of barley. But barley feldom fails after peafe. In ftrong clay foil, the following rotation anfwers. 1. Wheat after fallow and dung. 2. Beans fown under furrow as early as poffible. Above the beans, fow peafe end of March, half a boll per acre, and harrow them in. The two grains will ripen at the fame time. 3. Oats or barley on a winter furrow with grafs-feeds. 4. Hay for one year or two; the fecond growth paftured. Lay what dung can be fpared on the hay-ftubble, and fow wheat with a fingle furrow. 5. Wheat. 6. Beans or peafe. 7. Oats. Fallow again.

In addition to thefe, we fhall here ftate from the Agricultural Survey of Yorkfhire, an example of a rotation ufed in that county upon a marfh-land farm confifting of 432 acres of arable land, in which a very great number of hands and horfes appear to have been employed, but in which very valuable products are reared. "The foil, where the principal part of the potatoes are grown, is a good warp; the other part on which potatoes are alfo cultivated, a mixture of warp and fand: the remainder of the land, clay, with a fmall portion of warp, but too ftrong to grow potatoes, except about 70 acres, which is tolerably good potato-land,

land, but at too great a diſtance from the river. Graſs land only ſufficient to keep two milch cows, and horſes neceſſary for working the farm: 69 acres of the beſt warp land divided into three equal parts; 1. fallow, with from 16 to 20 loads of manure per acre; ſet it with potatoes; after, ſow wheat; and then fallow again: three acres of the ſame kind of land that is liable to be damaged by ſparrows when ſown with corn, is ſet with potatoes every year with about 10 loads of manure per acre each year: 84 acres of the lighter land is divided in the ſame manner, one-third fallow, with 10 loads of manure per acre; ſet potatoes and then ſow wheat, and fallow again: 42 acres of land, lately an old paſture divided into three parts; one-third flax, then ſown with rape, and after they come off, plough and harrow the land three or four times, and lay upon it about 20 loads of manure per acre, which will make it in great condition; after which ſet potatoes, then ſow flax again, and rape after: 150 acres divided into three parts; 1. fallow; 2. wheat; 3. beans, drilled at 9 inches diſtance, hand-hoed twice at 6s. per acre; fallow again, &c.: 80 acres of land that was lately in old graſs divided into four parts; fallow, wheat, beans drilled, and oats; then fallow again, &c. The remaining four acres thrown to any of the crops that are likely to fail. Rent 25s. per acre; aſſeſſments 5s. per acre.

"*Diſtribution of crops for 1795.*

	Acres.	Average Produce of an Acre.
Wheat, - -	121	from 3 to 5 quarters.
Beans, - -	70	from 3 to 6 quarters.
Oats, - -	20	from 6 to 10 quarters.
Flax, - -	14	from 45 to 55 ſtones.
Rape, - -	14	from 5 to 5 quarters.
Potatoes, - -	68	from 60 to 100 ſacks.
Fallow, - -	121	
To be thrown where a crop is likely to fail,	4	
	432	

"*Servants, Horſes, and Cows kept upon the Farm.*

4 Houſe ſervants,
16 Labourers,
26 Horſes,
2 Milch cows.

"The above is an account of a farm belonging to one of the beſt managers of marſh-land. We muſt obſerve, he fallows his land very often; yet he is well paid by his ſuperior crops. The laſt year (1795) he had 100 ſacks per acre off moſt of his potato-land; and ſold them from 8s. to 12s. per ſack of 14 pecks. All their corn is ſold by the quarter of eight Wincheſter buſhels, though I believe their meaſure rather overruns."

Sect. VI. *Of Reaping Corn and Hay Crops, and Storing them up for Uſe.*

458 Of ripeneſs.

Culmiferous plants are ripe when the ſtem is totally white: they are not fully ripe if any green ſtreaks remain. Some farmers are of opinion, that wheat ought to be cut before it is fully ripe. Their reaſons are, firſt, that ripe wheat is apt to ſhake; and next, that the flour is not ſo good. With reſpect to the laſt, it is contrary to nature, that any ſeed can be better in an unripe ſtate than when brought to perfection; nor will it be found ſo upon trial. With reſpect to the firſt, wheat, at the point of perfection, is not more apt to ſhake than for ſome days before: the huſk begins not to open till after the ſeed is fully ripe; and then the ſuffering the crop to ſtand becomes ticklish; after the minute of ripening, it ſhould be cut down in an inſtant, if poſſible.

This leads to the hands that are commonly engaged to cut down corn. In Scotland, the univerſal practice was, to provide a number of hands, in proportion to the extent of the crop, without regard to the time of ripening. By this method, the reapers were often idle for want of work; and what is much worſe, they had often more work than they could overtake, and ripe fields were laid open to ſhaking winds. The Lothians have long enjoyed weekly markets for reapers, where a farmer can provide himſelf with the number he wants; and this practice is creeping into neighbouring ſhires. Where there is no opportunity of ſuch markets, neighbouring farmers ought to agree in borrowing and lending their reapers. 459 Of reapers.

One ſhould imagine, that a caution againſt cutting corn when wet is unneceſſary; yet from the impatience of farmers to prevent ſhaking, no caveat is more ſo. Why do they not conſider, that corn ſtanding dries in half a day; when, in a cloſe ſheaf, the weather muſt be favourable if it dry in a month? in moiſt weather it will never dry.

With reſpect to the manner of cutting, we muſt premiſe, that barley is of all the moſt difficult grain to be dried for keeping. Having no huſk, rain has an eaſy acceſs; and it has a tendency to malten when wet. Where the ground is properly ſmoothed by rolling, it ſeems beſt to cut it down with the ſcythe. This manner being more expeditious than the ſickle, removes it ſooner from danger of wind; and gives a third more ſtraw, which is a capital article for dung, where a farm is at a diſtance from other manure. We except only corn that has lodged; for there the ſickle is more convenient than the ſcythe. As it ought to be dry when cut, bind it up directly: if allowed to lie any time in the ſwath, it is apt to be diſcoloured.—Barley ſown with graſs-ſeeds, red clover eſpecially, requires a different management. Where the graſs is cut along with it, the difficulty is great of getting it ſo dry as to be ventured in a ſtack. The beſt way is, to cut the barley with a ſickle above the clover, ſo as that nothing but clean barley is bound up. Cut with a ſcythe the ſtubble and graſs: they make excellent winter food. The ſame method is applicable to oats; with this only difference, that when the field is expoſed to the ſouth-weſt wind, it is leſs neceſſary to bind immediately after mowing. As wheat commonly grows higher than any other grain, it is difficult to manage it with the ſcythe; for which reaſon the ſickle is preferred in England. Peaſe and beans grow ſo irregularly, as to make the ſickle neceſſary. 460 Manner of cutting.

The beſt way for drying peaſe, is to keep ſeparate the handfuls that are cut; though in this way they wet eaſily, they dry as ſoon. In the common way of heap- 461 Drying of peaſe.

 ing

Reaping and Storing up Corn and Hay.

ing peafe together for compofing a fheaf, they wet as eafily, and dry not near fo foon. With refpect to beans, the top of the handful laft cut ought to be laid on the bottom of the former; which gives ready accefs to the wind. By this method peafe and beans are ready for the ftack in half the ordinary time.

462 Size of fheaves.

A fheaf commonly is made as large as can be contained in two lengths of the corn made into a rope. To fave frequent tying, the binder preffes it down with his knee, and binds it fo hard as totally to exclude the air. If there be any moifture in the crop, which feldom fails, a procefs of fermentation and putrefaction commences in the fheaf; which is perfected in the ftack, to the deftruction both of corn and ftraw. How ftupid is it, to make the fize of a fheaf depend on the height of the plants! By that rule, a wheat fheaf is commonly fo weighty, as to be unmanageable by ordinary arms: it requires an effort to move it that frequently burfts the knot, and occafions lofs of grain, befide the trouble of a fecond tying. Sheaves ought never to be larger than can be contained in one length of the plant, cut clofe to the ground; without admitting any exception, if the plants be above 18 inches high. The binder's arm can then comprefs the fheaf fufficiently without need of his knee. The additional hands that this way of binding may require, are not to be regarded compared with the advantage of drying foon. Corn thus managed may be ready for the ftack in a week; it feldom in the ordinary way requires lefs than a fortnight, and frequently longer. Of a fmall fheaf compreffed by the arm only, the air pervades every part; nor is it fo apt to be unloofed as a large fheaf, however firmly bound. We omit the gathering of fheaves into fhocks, becaufe the common method is good, which is to place the fhocks directed to the fouth-weft, in order to refift the force of the wind. Five fheaves on each fide make a fufficient ftay; and a greater number cannot be covered with two head-fheaves.

463 Carrying off the victual.

Every article is of importance that haftens the operation in a country, like Scotland, fubjected to unequal harveft weather; for which reafon, the moft expeditious method fhould be chofen for carrying corn from the field to the ftack-yard. Our carriages are generally too fmall or too large. A fledge is a very awkward machine: many hands are required, and little progrefs made. Waggons and large carts are little lefs dilatory, as they muft ftand in the yard till unloaded fheaf by fheaf. The beft way is, to ufe long carts moveable upon the axle, fo as at once to throw the whole load on the ground; which is forked up to the ftack by a hand appointed for that purpofe. By this method, two carts will do the work of four or five.

464 Of ftacking.

Building round ftacks in the yard is undoubtedly preferable to houfing corn. There it is fhut up from the air; and it muft be exceeding dry, if it contract not a muftinefs, which is the firft ftep to putrefaction. Add to this, that in the yard, a ftack is preferved from rats and mice, by being fet on a pedeftal: whereas no method has hitherto been invented for preferving corn in a houfe from fuch deftructive vermine. The proper manner of building, is to make every fheaf incline downward from its top to its bottom. Where the fheaves are laid horizontally, the ftack will take in rain both above and below. The beft form of a ftack is that of a cone placed on a cylinder; and the top of the cone fhould be formed with three fheaves drawn to a point. If the upper part of the cylinder be a little wider than the under, fo much the better.

465 Covering the ftacks.

The delaying to cover a ftack for two or three weeks, though common, is, however, exceeding abfurd; for if much rain fall in the interim, it is beyond the power of wind to dry the ftack. Vegetation begun in the external parts, fhuts out the air from the internal; and to prevent a total putrefaction, the ftack muft be thrown down and expofed to the air every fheaf. In order to have a ftack covered the moment it is finifhed, ftraw and ropes ought to be ready; and the covering ought to be fo thick as to be proof againft rain.

Scotland is fubject not only to floods of rain, but to high winds. Good covering guards againft the former, and ropes artfully applied guard againft the latter. The following is a good mode. Take a hay-rope well twifted, and furround the ftack with it, two feet or fo below the top. Surround the ftack with another fuch rope immediately below the eafing. Connect thefe two with ropes in an up-and-down pofition, diftant from each other at the eafing about five or fix feet. Then furround the ftack with other circular ropes parallel to the two firft mentioned, giving them a twift round every one of thofe that lie up and down, by which the whole will be connected together in a fort of net-work. What remains is, to finifh the two feet at the top of the ftack. Let it be covered with bunches of ftraw laid regularly up and down; the under part to be put under the circular rope firft mentioned, which will keep it faft, and the upper part be bound by a fmall rope artfully twifted, commonly called *the crown of the ftack*. This method is preferable to the common way of laying long ropes over the top of the ftack, and tying them to the belting-ropes; which flattens the top, and makes it take in rain. A ftack covered in the way here defcribed, will ftand two years fecured both againft wind and rain; a notable advantage in this variable climate.

466 Hay-making.

The great aim in making hay is, to preferve as much of the fap as poffible. All agree in this; and yet differ widely in the means of making that aim effectual. To defcribe all the different means would be equally tedious and unprofitable. We fhall confine ourfelves to two, which appear preferable to all others. A crop of rye-grafs and yellow clover ought to be fpread as cut. A day or two after, when the dew is evaporated, rake it into a number of parallel rows along the field, termed *wind-rows*, for the convenience of putting it up into fmall cocks. After turning the rows once and again, make fmall cocks weighing a ftone or two. At the diftance of two days or fo, put two cocks into one, obferving always to mix the tops and bottoms together, and to take a new place for each cock, that the leaft damage poffible may be done to the grafs. Proceed in putting two cocks into one, till fufficiently dry for tramp-ricks of 100 ftone each. The eafieft way of erecting tramp-ricks, is to found a rick in the middle of the row of cocks that are to compofe it. The cocks may be carried to the rick by two perfons joining arms together. When all the cocks are thus carried to the rick within the diftance of 40 yards or fo, the reft of the cocks will be more expeditioufly carried to the rick, by a rope wound about them and dragged by a horfe.

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horse. Two ropes are sufficient to secure the ricks from wind the short time they are to stand in the field. In the year 1775, 10,000 stone were put into tramp-ricks the fourth day after cutting. In a country so wet as many parts of Scotland are, expedition is of mighty consequence in the drying both of hay and corn. With respect to hay intended for horned cattle, it is by the generality held an improvement, that it be heated a little in the stack. But we violently suspect this doctrine to have been invented for excusing indolent management. An ox, it is true, will eat such hay; but it will always be found that he prefers sweet hay; and it cannot well be doubted, but that such hay is the most salutary and the most nourishing.

467 Hay of red clover.

The making hay consisting chiefly of red clover, requires more care. The season of cutting is the last week of June, when it is in full bloom; earlier it may be cut, but never later. To cut it later would indeed produce a weightier crop; but a late first cutting makes the second also late, perhaps too late for drying. At the same time, the want of weight in an early first cutting, is amply compensated by the weight of the second.

When the season is too variable for making hay of the second growth, mix straw with that growth, which will be a substantial food for cattle during winter. This is commonly done by laying strata of the straw and clover alternately in the stack. But by this method, the strata of clover, if they do not heat, turn mouldy at least, and unpalatable. The better way is, to mix them carefully with the hand before they be put into the stack. The dry straw imbibes moisture from the clover and prevents heating.

468 Other method.

* *Essays on Agriculture*, vol. i. p. 136.

But the best method of hay-making seems to be that recommended by Mr Anderson *. "Instead (says he), of allowing the hay to lie, as usual in most places, for some days in the swathe after it is cut, and afterwards alternately putting it up into cocks and spreading it out, and tedding it in the sun, which tends greatly to bleach the hay, exhales its natural juices, and subjects it very much to the danger of getting rain, and thus runs a great risk of being good for little, I make it a general rule, if possible, never to cut hay but when the grass is quite dry; and then make the gatherers follow close upon the cutters, putting it up immediately into small cocks about three feet high each when new put up, and of as small a diameter as they can be made to stand with; always giving each of them a slight kind of thatching, by drawing a few handfuls of the hay from the bottom of the cock all around, and laying it lightly upon the top with one of the ends hanging downwards. This is done with the utmost ease and expedition; and when it is once in that state, I consider my hay as in a great measure out of danger: for unless a violent wind should arise immediately after the cocks are put up, so as to overturn them, nothing else can hurt the hay; as I have often experienced, that no rain, however violent, ever penetrates into these cocks but for a very little way. And, if they are dry put up, they never sit together so closely as to heat; although they acquire, in a day or two, such a degree of firmness, as to be in no danger of being overturned by wind after that time, unless it blows a hurricane.

"In these cocks I allow the hay to remain, until, upon inspection, I judge that it will keep in pretty large tramp-cocks (which is usually in one or two weeks, according as the weather is more or less favourable), when two men, each with a long pronged pitchfork, lift up one of these small cocks between them with the greatest ease, and carry them one after another to the place where the tramp-cock is to be built (1): and in this manner they proceed over the field till the whole is finished.

469 Advantages of this method.

"The advantages that attend this method of making hay, are, that it greatly abridges the labour; as it does not require above the one-half of the work that is necessary in the old method of turning and tedding it: That it allows the hay to continue almost as green as when it is cut, and preserves its natural juices in the greatest perfection; for, unless it be the little that is exposed to the sun and air upon the surface of the cocks, which is no more bleached than every straw of hay saved in the ordinary way, the whole is dried in the most slow and equal manner that could be desired; and, lastly, That it is thus in a great measure secured from almost the possibility of being damaged by rain. This last circumstance deserves to be much more attended to by the farmer than it usually is at present; as I have seen few who are sufficiently aware of the loss that the quality of their hay sustains by receiving a slight shower after it is cut, and before it is gathered; the generality of farmers seeming to be very well satisfied if they get in their hay without being absolutely rotted, never paying the least attention to its having been several times wetted while the hay was making. But, if these gentlemen will take the trouble at any time to compare any parcel of hay that has been made perfectly dry, with another parcel from the same field that has received a shower while in the swathe, or even a copious dew, they will soon be sensible of a very manifest difference between them; nor will their horses or cattle ever commit a mistake in choosing between the two.

470 Particular caution requisite in this method.

"Let it be particularly remarked, that in this manner of making hay, great care must be taken that it be dry when first put into the cocks; for if it is in the least degree wet at that time, it will turn instantly mouldy, and sit together so as to become totally impervious to the air, and will never afterwards become dry till it is spread out to the sun. For this reason, if at any time during a course of good settled weather you should begin to cut in the morning before the dew is off the grass, keep back the gatherers till the dew is evaporated; allowing that which was first cut to lie till it is dry before it is cocked. In this case, you will almost

(1) If the hay is to be carried to any considerable distance, this part of the labour may be greatly abridged, by causing the carriers take two long sticks of a sufficient strength, and having laid them down by the small cocks parallel to one another, at the distance of one and a half, or two feet asunder, let them lift three or four cocks, one after another, and place them carefully above the sticks, and then carry them altogether, as if upon a handbarrow, to the place where the large rick is to be built.

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most always find that the uncut grass will dry sooner than that which has been cut when wet; and, therefore, the gatherers may always begin to put up that which is fresh cut before the other; which will usually require two or three hours to dry after the new-cut hay may be cocked. And if, at any time, in case of necessity, you should be obliged to cut your hay before it is dry, the same rule must be observed always to allow it to remain in the swathe till it is quite dry: but, as there is always a great risk of being long in getting it up, and as it never in this case *wins* (K) so kindly as if it had been dry cut, the farmer ought to endeavour, if possible, in all cases, to cut his hay only when dry; even if it should cost him some additional expence to the cutters, by keeping them employed at any other work, or even allowing them to remain idle, if the weather should be variable or rainy.

"But if there is a great proportion of clover, and the weather should chance to be close and calm at the time, it may, on some occasions, be necessary to open up these cocks a little, to admit some fresh air into them; in which case, after they have stood a day or two, it may be of great use to turn these cocks and open them up a little, which ought to be done in the driest time of the day; the operator taking that part of each cock which was the top, and with it forming the base of a new one; so that the part which was most exposed to the air becomes excluded from it, and that which was undermost comes to be placed upon the top, so as to make it all dry as equally as possible.

"If the hay has not been damp when it was first put up, the cock may be immediately finished out at once; but if it is at all wet, it will be of great use to turn over only a little of the top of the cock at first, and leaving it in that state to dry a little, proceed to another, and a third, and fourth, &c. treating each in the same way; going on in that manner till you find that the inside of the first opened cock is sufficiently dried, when it will be proper to return to it, turning over a little more of it till you come to what is still damp, when you leave it and proceed to another, and so on round the whole; always returning afresh till the cocks are entirely finished. This is the best way of saving your hay, if you have been under the necessity of cutting it while damp; but it is always best to guard against this inconvenience, if possible."

471 Hay-stacks.

In the yard, a stack of hay ought to be an oblong square, if the quantity be greater than to be easily stowed in a round stack; because a smaller surface is exposed to the air than in a number of round stacks. For the same reason, a stack of pease ought to have the same form, the straw being more valuable than that of oats, wheat, or barley. The moment a stack is finished it ought to be covered; because the surface hay is much damaged by withering in dry weather, and moistening in wet weather. Let it have a pavilion-roof; for more of it can be covered with straw in that shape, than when built perpendicular at the ends. Let it be roped as directed above for corn-stacks; with this difference only, that in an oblong square the ropes must be thrown over the top, and tied to the belt-rope below. This belt-rope ought to be fixed with pins to the stack: the reason is, that the ropes thrown over the stack will bag by the sinking of the stack, and may be drawn tight by lowering the belt rope, and fixing it in its new position with the same pins.

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The stems of hops, being long and tough, make excellent ropes; and it will be a saving article, to propagate a few plants of that kind for that very end.

A stack of rye-grass hay, a year old, and of a moderate size, will weigh, each cubic yard, 11 Dutch stone. A stack of clover-hay in the same circumstances weighs somewhat less.

Sect. VII. *Manures.*

"The use of manures (says M. Parmentier*), has been known in all ages; but we are yet far from having any clear and precise ideas of the nature of the juices which are destined for the nourishment of vegetables, and of the manner in which they are transmitted to their organs. The writers on agriculture, who have endeavoured to explain these matters, perceiving salts in most plants, were persuaded that these salts, by the help of water and heat, passed, in a saline form, through the vegetable filter. These first philosophers did not hesitate to consider every thing that has been done by the industry of man, to improve the nature of land, and its productions, as merely forming reservoirs of these salts, which they considered as the principle of fertility. This opinion was so well established among the improvers of land, that, to this day, many of them have no object in view, in their operations, but to disengage salts; and, when they attempt to explain certain phenomena which take place in their fields or orchards, they talk confidently about the *nitre of the air*, *of rain*, *of snow*, *of dew*, *and fogs*; of the *salts of the earth*, *of dung*, *of marl*, *of lime*, *of chalk*, &c. and make use of those vague terms, *oil*, *sulphur*, *spirit*, &c. which ought henceforward to be banished from our elementary books on agriculture.

* *Memoirs of the Royal Society of Agriculture, Paris.*

472 M. Parmentier's opinions concerning manure.

"Among the authors who have attacked, and combated with most success, the opinion that the fruitfulness of soils, and the aliment of vegetables, reside in saline substances, must be reckoned Eller and Wallerius. These philosophers examined, by every means which chemistry at that time could furnish, the various kinds of earth proper for cultivation, and also those substances which have always been considered as the most powerful manures, without being able to obtain, from any of them, any thing more than mere atoms of salt.

"Animated with the same zeal, and taking advantage of the instructions found in their writings, I thought it necessary to determine, by experience, whether, as has been asserted, there really exist neutral salts in earths; and also, whether those earths are more fertile in proportion to the quantity of such salts they contain. With this view, I lixiviated, by means of distilled water, many species of cultivated earths, taken in various states, from fresh earth to that which had

(K) By *winning* hay, is meant the operation by which it is brought from the succulent state of grass to that of a dry fodder.

had been impoveriſhed by the growth of ſeveral crops: I alſo tried dung, reduced more or leſs into the ſtate of mould; and likewiſe the moſt active manures, ſuch as the offal of animal ſubſtances rotted by putrefaction; but in none of theſe, however carefully analyzed, were found any ſalts in a free ſtate. They contain indeed the materials proper for forming ſalts, but if they contain any ready formed, it is merely by accident.

"The reſearches of Kraft, and thoſe of Alſton, were not attended with different reſults. Having ſown ſome oats in aſhes, not lixiviated, and in ſand ſtrongly impregnated with potaſh and with ſaltpetre, and having found that the oats did not grow, they concluded that neutral ſalts, and alkalies, not only retarded the growth of vegetables, but that they abſolutely prevented it. It is well known that in Egypt there are diſtricts where the earth is entirely covered with ſea-ſalt, and theſe diſtricts are quite barren. It is probably owing to this property of ſea-ſalt, that the Romans were accuſtomed to ſcatter large quantities of it over fields where any great crime had been committed, and of which they wiſhed to perpetuate the remembrance, by rendering the part barren for a certain time.

"The idea that ſalts had great influence in vegetation ought to have been greatly weakened by the following ſimple reflection. Suppoſing that ſalts exiſted in garden-mould, they would be very ſoon diſſolved by the rain, and carried away, towards the lower ſtrata of the earth, to a depth to which the longeſt roots would not reach. Indeed the famous experiment of Van Helmont would have been ſufficient to have deſtroyed the above opinion, if it did not generally happen that we are no ſooner ſet free from one error than we fall into another not leſs extraordinary. The ſurpriſing effects of vegetation brought about by the overflowing of water, and in the neighbourhood of ſalt marſhes, and the infinite number of inhaling capillary tubes obſerved upon the ſurface of vegetables, led to an opinion that the air and water, abſorbed by the roots and leaves of plants, were only vehicles loaded with ſaline matter, analogous to the vegetables nouriſhed by them.

"To the experiment of Van Helmont, which was repeated by many accurate obſervers, ſucceeded thoſe of modern philoſophers; from which it clearly appeared, that plants could grow, and produce fruit, in the air of the atmoſphere, and in diſtilled water, alſo in pure ſand, in powdered glaſs, in wet moſs or ſponge, in the cavity of fleſhy roots, &c. and that plants which had nothing but the above-mentioned fluids for their nouriſhment, gave, when ſubmitted to chemical analyſis, the ſame products as thoſe which had undergone their proceſs of vegetation in a ſoil perfectly well manured. It was alſo obſerved, that the moſt barren ſoils were rendered fertile when they were properly ſupplied with water by canals; and the efficacy of irrigation was repeatedly evinced in different ways: from theſe obſervations was formed the following ſyſtem, that water riſes in plants in the form of vapour, as in diſtillation; that air introduces itſelf into their pores; and that, if ſalts contribute to the fruitfulneſs of ſoils, it is only in conſequence of their containing the two fluids above mentioned in great abundance."

Our author, after making many experiments upon various ſoils and ſalts, maintains "that ſaline ſubſtances have no ſenſible effects in promoting vegetation, except inaſmuch as they are of a deliqueſcent nature, have an earthy baſis eaſily decompoſed, and are uſed only in ſmall quantity. In thoſe circumſtances they have the power of attracting, from the immenſe reſervoir of the atmoſphere, the vapours which circulate in it; theſe vapours they retain, along with the moiſture that is produced from rain, ſnow, dew, fog, &c. which moiſture they prevent from running together in a maſs, or from being loſt, either by exhaling into the air of the atmoſphere, or by filtering itſelf through the inferior ſtrata of the earth, and thereby leaving the roots of vegetables dry; they diſtribute that moiſture uniformly, and tranſmit it, in a ſtate of great diviſion, to the orifices of the tubes deſtined to carry it into the texture of the plant, where it is afterwards to undergo the laws of aſſimilation. As every kind of vegetable manure poſſeſſes a viſcous kind of moiſture, it thereby partakes of the property of deliqueſcent ſalts. In ſhort, the preparation of land for vegetation has no other object in view but to divide the earthy particles, to ſoften them, and to give them a form capable of producing the above-mentioned effects. It is ſufficient, therefore, that water, by its mixture with the earth and the manure, be divided, and ſpread out ſo as to be applied only by its ſurface, and that it keep the root of the plant always wet, without drowning it, in order to become the eſſential principle of vegetation. But as plants which grow in the ſhade, even in the beſt ſoil, are weakly, and as the greater part of thoſe which are made to grow in a place that is perfectly dark neither give fruit nor flowers, it cannot be denied, that the influence of the ſun is of great importance in vegetable economy."

Such was the opinion of M. Parmentier while the old theory of chemiſtry prevailed; but when it appeared, by more recent diſcoveries, that air and water are not ſimple but compound bodies, made up of oxygen, hydrogen, and azote, and that they are reſolved into theſe principles by many operations of nature and of art, he ſo far altered his theory of vegetation as to admit, that air and water act their part in that proceſs, not in a compound ſtate, but by means of the principles of which they conſiſt. He now concluded, that the value of manured earth conſiſts of its tendency to reſolve water into gaſſes which give out heat while they are abſorbed by the plants. As he thus ſuppoſes that the gaſſes conſtitute the food of plants, it follows, that the moſt aerated waters will be the moſt favourable to vegetation; and hence ariſes the value of thoſe in which putrid animal matters are diſſolved. Salts and dung act as leavens in bringing on a ſtate of fermentation in the ſubſtances with which they are mingled, and operating the decompoſition of water, which, along with the carbon exiſting in the atmoſphere, he imagines contains the whole materials of the more ſimple vegetables. Too great a quantity of ſalts prevents fermentation, or the decompoſition of water, and hence is prejudicial to vegetation, while a ſmall quantity is more advantageous, as more favourable to that proceſs of putrefaction. Different manures alſo give forth gaſſes which are abſorbed by plants, and give them a peculiarity of character: hence, in a ſoil compoſed of mud and dung, cabbages acquire a bad taſte, from the hepatic gas, or ſulphurated hydrogen gas, which is there evolved. In addition to theſe chemical properties

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properties of manure, it alſo, by its mechanical qualities, renders the ſoil more permeable to water and to the roots of the plants, and is thus favourable to the proceſs of vegetation. At the ſame time, as the earths themſelves have a chemical action upon water, and are capable of affording a proper baſis for plants, he conſiders them as in many caſes ſufficient to promote vegetation. Upon theſe principles, M. Parmentier takes a view of different ſubſtances uſed as manures.

Marl, in his opinion, is capable of acting in the ſame manner as the moſt fertile ſoil, when the principles of which it is compoſed, namely, clay, ſand, calcareous earth, and magneſian earth, are juſtly proportioned to each other. But it is ſometimes compact and tenacious, becauſe it contains a ſuperabundant portion of clay, and at other times porous and friable, becauſe it contains too much ſand, and therefore is not in general fit for vegetation by itſelf. Theſe conſiderations ought always to be our guide when we mean to employ marl as a manure.

It has been ſuppoſed that *to marl* is a ſort of technical expreſſion, intended to denote the bringing together or dividing the earthy particles by means of clay or ſand. It appears to our author, that neither of the above operations can properly be called *marling*; becauſe, in either caſe, all we do is, to put the ſoil into a ſituation to receive and to profit by the influence of the atmoſphere, and that of the manures made uſe of. The peculiar principle of marl is, that part of it which, like lime, acts very powerfully upon the different aeriform fluids, is eaſily reduced to powder, effervesces with acids, and ſends forth a quantity of air-bubbles when water is poured upon it. Now this matter, which in a particular manner does the office of manure, reſides neither in clay nor in ſand. Upon the proportion of it depends the duration of the fertility it produces; conſequently it is of importance, when we make uſe of marl, to know which of its conſtituent parts it contains in the greateſt proportion, otherwiſe in ſome caſes we ſhould only add one common kind of earth to another. Hence our author infers, that for a chalky ſoil clay is the proper manure, and that in ſuch a ſoil a clay bottom is of more value than a gold mine.

"Wood-aſhes, as a manure, may be, in ſome reſpects, compared to marl; at leaſt they contain the ſame earth as thoſe which generally enter into the compoſition of marl, but they contain a greater quantity of ſaline ſubſtances, proceeding from the vegetables of which they are the reſidue, and from the proceſs made uſe of in their combuſtion; a proceſs which increaſes their activity, and ſhould render us careful in what manner and for what purpoſes we employ them. Wood-aſhes, when ſcattered over fields, at proper times and in proper quantities, deſtroy weeds, and encourage the vegetation of good plants. But do the aſhes produce this effect by a ſort of corroſive power? I cannot (ſays our author) think it; for in that caſe all kinds of plants would indiſcriminately be acted upon by them, and to a certain degree deſtroyed.

"Beſides, the aſhes of freſh wood are ſeldom employed until they have been lixiviated; in which ſtate they are deprived of their cauſtic principle; thoſe aſhes which are moſt commonly made uſe of for manure are produced either from wood that has been floated in water, or from turf, or from pit-coal, and contain little or no alkaline ſalt.

"It appears much more probable that aſhes, when laid upon ground, deſtroy the weeds by a well known effect, namely, by ſeizing with eagerneſs that moiſture which ſerved to produce thoſe weeds, and which in a ſuperabundant quantity is neceſſary to their exiſtence and ſupport. Whereas thoſe plants which have a firmer texture and a longer root, which are rendered ſtrong by age and by having withſtood the rigour of winter, and which are in fact the plants of which the fields are compoſed, do not ſuffer any damage from the application of the aſhes; but, on the contrary, by being freed from the ſuperfluous weeds which ſtifled them, and robbed them of a part of their ſuſtenance, they receive a quantity of nouriſhment proportioned to their wants. The ſtate of relaxation and languor to which they were reduced by a ſuperabundance of water, leaves them, the ſoil gets its proper conſiſtence, and the graſs, corn, &c. acquiring the ſtrength and vigour which is natural to them, ſoon overcome the moſs, ruſhes, and other weeds; thus a good crop, of whatever the field conſiſts of, is produced. It is in the above manner that wood aſhes act, whenever in the ſpring it is neceſſary to apply them to meadows, corn fields, &c. the plants of which are ſtifled and weakened by a luxuriant vegetation of weeds, the uſual conſequence of mild and wet winters.

"When wood-aſhes produce an effect different from what is above deſcribed, it is either becauſe they happen to contain too much alkaline ſalt, or that they are laid on the ground in too great quantity, or that the fields to which they are applied were not ſufficiently wet to reſtrain their action; for when they are ſcattered upon cold ſoils, and buried by the plough before the time of ſowing, they are, like lime, of great ſervice. The laſt-mentioned ſubſtance is very efficacious in other circumſtances; and there is a well known method of uſing it practiſed by the Germans, as follows: A heap of lime is formed by the ſide of a heap of poor earth, and water is poured upon the lime; the earth is then thrown over it, and becomes impregnated with the vapours which eſcape from the lime while it is ſlaked. The earth, after being thus aerated, may be ſeparated; and although no lime remains mixed with it, is, by the operation juſt deſcribed, rendered capable of giving a luxuriant vegetation to whatever plants may be put into it.

"It is poſſible, therefore, to aerate earth as well as fluids; for this purpoſe, by mixing it with certain ſubſtances during their decompoſition, we muſt attach to it the principles of which thoſe ſubſtances are compoſed; from which there reſults a matter ſo loaded with gas, as to form a more compound ſubſtance, and one which has acquired new properties. The Arabians, for example, who take great pains to improve their land, are accuſtomed to make large pits, which they fill with animals which happen to die: theſe pits they afterwards cover with calcareous or clayey earth; and after ſome time theſe earths, which of themſelves are ſterile, acquire the properties of the richeſt manures.

"The foregoing obſervations may at leaſt be conſidered as proving, that thoſe ſubſtances which, when employed freſh and in too great quantity, are moſt prejudicial to vegetation, have, on the contrary, an advantageous

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tageous effect, when they are previously made to undergo a fermentation; or when they are mixed with earth or water, in a proportion adapted to the end proposed. The grass of fields in which cattle or poultry go to feed, after the first or second crop of hay, appears to be dried by the urine and dung of those animals, as if fire had been applied to it; whereas these same excrementitious substances, when combined with earth, or diluted with water, are capable, without any other preparation, of performing the office of good manure.

"But if animal secretions, when applied in substance to plants, were capable of acting upon them, as is affirmed, in such a way as to corrode or burn them, how could seed which has been swallowed, and escaped the action of the digestive powers, be prolific when thrown out by the animal, after having remained so long in its dung? yet we often see oats, so circumstanced, grow and produce seed. Is it not more consistent with experience and observation to suppose, that these excrementitious substances, being still endowed with animal heat, and with an organic motion, diffuse round plants in vegetation a deleterious principle or inflammable gas, which destroys them? for soon after their application, the foliage of the plant grows yellow, dries up, and the plant withers, unless there happens a shower of rain which revives it. When these substances are diluted, by being mixed with water and earth, they lose that principle which is so destructive to vegetable life, and an incipient fermentation augments their power as a manure, so that they may be immediately made use of without any apprehension of injury from their effects.

"It appears, therefore, that any operation upon excrementitious substances, by which they are dried and reduced to powder, cannot be practised without depriving those substances of a great part of such of their principles as are easily evaporated, and upon which their fluidity depends; these principles, when diluted with water, and confined by being mixed with earth, are capable of increasing the produce of the soil. Such is the way in which the husbandmen in Flanders make use of this kind of manure, in the cultivation of a kind of rape or cole seed, which is to them a very important branch of agricultural industry and commerce; and they never observe that the sap carries up any of those principles which give such manure its offensive smell; nor do they observe, that the fodder produced from fields so manured, whether eaten fresh or dry, is disagreeable to their cattle. The excrements of all animals would be injurious to plants, if applied too fresh, or in too great quantity; and a gardener could not commit a greater fault, than to put more than a certain quantity of them into the water he means to make use of to water his young plants; in short, this kind of manure is to be used in a very sparing manner; and he that is too prodigal of it will find, to his cost, that excess, even of that which is otherwise beneficial, becomes an evil.

"It must certainly be allowed, that excrementitious substances are a very advantageous manure for cold soils, and suited to most vegetable productions; a long experience of their effects over a large tract of country, and the acknowledged intelligence of the Flemish farmers, ought to be considered as sufficient to overcome the prejudice that has been raised against this sort of manure. Supposing that the bad effects which have been attributed to it, when used in the state in which it is taken out of privies, &c. are not the offspring of a prejudiced imagination, they may have arisen from its having been made use of at an improper time, or in too great quantity; or from its having been applied to a soil and for the cultivation of plants to which it was not adapted; for we know that the excess of any kind of manure changes the smell and taste of plants, and the same effect is produced by watering them too frequently. Striking examples of this change are seen in the strawberry and in the violet, when such as have grown in the woods are compared to those produced from some of our over-manured gardens; also in the lettuce, and some other plants, when those raised for sale by the gardeners about Paris are compared to those of some particular kitchen gardens. In the markets of some cities, the carrots, turnips, and potatoes of the fields, are preferred to the same kind of roots cultivated by the gardeners; for though the last are of a larger size, they have not so good a flavour. Some vegetables, therefore, are like certain wild species of the animal kingdom; they resist every kind of culture, as those animals resist every effort to tame them.

"Although experience has taught the Flemish farmers, that excrementitious substances are more active in their natural state than when dried, yet it cannot be denied that drying them, and reducing them into powder, is sometimes very advantageous, because in that state they are much less offensive, are easily transported to any distance, and may be used when most convenient or most proper. In many cities the inhabitants pay to have their privies emptied: in other places, those who empty them pay for their contents; and it would astonish any one to be told how great a revenue is produced in the city of Lisle in Flanders by the sale of this kind of manure. I am, however (says our author), far from thinking that it is right, in all cases, to employ it in the above-mentioned state of concentration; it would be better, in my opinion, to follow the example of the Flemish farmers, who use it the first year for the cultivation of plants for oil, or for hemp or flax; and the second year for the best kinds of grain: thus obtaining two crops, instead of one, without any farther preparation of the land. What is said above may be applied also to the manures produced from the dung of cattle, poultry, &c. (particularly to pigeons dung, the most powerful manure of its kind), all which, by being dried and powdered before they are used, lose a great portion of their activity. From these observations another fact may be deduced, namely, that manure should not be taken from the place where it has been thrown together until the season of the year and the state of the land are such that it may be put into the ground as soon as it is brought to it. In some districts a very injurious custom prevails of carrying the manure into the fields, and leaving it there formed into small heaps, exposed for some days to the elements; during which time, either the sun and wind dry up its natural moisture, leaving a mass which is much less active; or the rain dissolves and carries away the extractive part impregnated with the salt. This kind of brine, which is the most powerful part of the manure, penetrates the earth to a considerable depth, and shews (by the thick tufts which arise in those places, and which produce more straw than grain) that manure

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ought to be put into the ground as soon as it is brought to it, because it then possesses its full force and effect, and consequently would be then used to the greatest advantage.

"We have always at hand the means of composing, from a great variety of vegetable and animal substances, such manures as, when brought into a proper state, and mixed with land, contribute to its fertility. Chemistry also offers to us a number of substances, which, although when used separately they tend to diminish the fertilizing quality of the earth, are yet capable, by being combined, of forming excellent manures; such, for instance, is that saponaceous combination which is produced from a mixture of potash, oil, and earth. What an advantage it would be, if, instead of being sparing of manure, the inhabitants of the country would endeavour to increase the number of these resources, and to render them more beneficial, by employing them in a more effectual manner! How many years had passed before it was known that the refuse of apples and pears, after they are pressed (and which used to be thrown away as useless), is capable of forming as valuable a manure, in cyder and perry countries, as the refuse of grapes does in wine countries!"

From what has been observed, our author concludes, that manures act, in many circumstances, like medicines, and consequently that the same sort of manure cannot be adapted to every situation, and every kind of soil; we must therefore take care to make proper distinctions between them. Whoever shall pretend that any particular kind of manure may be used, with equal benefit, in grass land, corn fields, vineyards, orchards, kitchen gardens, &c. ought to be classed amongst those quacks who undertake to cure all persons with the same remedy, without any regard to their age, constitution, &c. It is probably from not having paid sufficient attention to the forementioned distinctions, that some authors have found fault with particular manures, while others have spoken too highly in their favour.

473 Practical rule for forming manures.

Having thus far stated the observations of this ingenious author, we think it necessary to remark, that the practical farmer, who wishes to advance safely and prosperously in his occupation, will probably find, that the best principle upon which he can proceed in forming his plans for the preparation of manure, will consist of keeping strictly in view the ideas which we formerly stated*, when considering the theory of agriculture. When we wish to fertilize land by art, we ought to follow nature, or to imitate the process by which she fertilizes it. Vegetable substances, fermented by the putrefaction of animal matters, rapidly fall down into earth, and assume the form of that rich black mould which is the most productive of all soils. The great object of the husbandman, therefore, ought to be to procure large quantities of vegetable substances of every kind, such as straw, stubble, rushes, weeds, &c. and to lay these up to ferment along with the fresh dung of animals, particularly those animals which chew the cud, for by digesting their food in a very perfect manner, their dung contains a large portion of animal matter. As horses, on the contrary, digest their food very weakly, their dung is often only sufficiently animalized to bring on its own fermentation, which, however, is very strong, on account of the large quantity of bits of straw, hay, and other undecomposed parts of their food which it contains. In the neighbourhood of cities, other animal substances, besides dung, may frequently be obtained; such as bullocks blood, and the refuse of works in which train oil is prepared, none of which ought to be neglected by the husbandman.

* N° 75, 76, 77, 78.

The art of fermenting vegetable by animal matters, or the true art of making dung, has not yet been brought to perfection, nor is it in almost any situation sufficiently attended to. In many places, we see large quantities of ferns, rushes, and the coarse grass of bogs, which no cattle will consume, allowed to run to waste; whereas, though these plants do not readily of themselves run into fermentation, they might easily, by proper care, be made to undergo this process, and consequently be converted into a source of riches, that is, into fertile mould. On this subject, we shall here state a mode of preparing dung upon the above principles, that has lately been discovered, and successfully adopted in Mid Lothian by the Hon. Lord Meadowbank, one of the senators of the College of Justice in Scotland. It consists of subjecting common peat-moss to the process of fermentation, now mentioned, and has been explained by his lordship in a small printed pamphlet, of which, though not sold to the public, a considerable number of copies have been distributed among his lordship's friends. It is in the following terms: "It is proper to state in the outset", says his lordship, "some general facts concerning the preparation of manure, which every practical farmer should be acquainted with.

474 Lord Meadowbank's mode of converting moss into manure.

"1. All recently dead animal or vegetable matter, if sufficiently divided, moist, and not chilled nearly to freezing, tends spontaneously to undergo changes, that bring it at length to be a fat greasy earth, which, when mixed with sands, clays, and a little chalk, or pounded limestone, forms what is called rich loam, or garden-mould.

"2. In vegetable matter, when amassed in quantities, these changes are at first attended with very considerable heat, (sometimes proceeding the length of inflammation), which, when not exceeding blood-heat, greatly favours and quickens the changes, both in animal matter, and the further changes in vegetable matter, that are not sensibly attended with the production of heat. The changes attended with heat, are said to happen by a fermentation, named from what is observed in making of ale, wine, or vinegar. The latter are ascribed to what is called *putrefactive fermentation*.

"3. Besides moderate moisture and heat, and that division of parts which admits the air in a certain degree, circumstances which seem to be necessary to the production of these changes, stirring, or mechanical mixture, favours them; and a similar effect arises from the addition of chalk, pounded limestone, lime, rubbish of old buildings, or burnt lime brought back to its natural state; and also of ashes of burnt coal, peat, or wood, soap-leys, soot, sea-shells, and sea-ware. And, on the other hand, the changes are stopped or retarded by pressure or consolidation, excluding air; by much water, especially when below the heat of a pool in summer; by astringents; and by caustic substances, as quicklime, acids, and pure alkalies, at least till their causticity is mollified, at the expence of the destruction of part of the animal and vegetable matter to which they are added.

"4. These

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" 4. Thefe changes are accomplifhed by the feparation or decompofition of the parts or ingredients of which the dead vegetables and animals are compofed; by the efcape of fomewhat of their fubftance in the form of vapours or gaffes; by the imbibing alfo fomewhat from water and from the atmofphere; and by the formation of compound matters, from the reunion of parts or ingredients, which had been feparated by the powers of the living vegetables and animals. The earlier changes, and in general thofe which take place previous to the deftruction of the adhefion and texture of the dead vegetables and animals, appear to be rather pernicious than favourable to the growth of living vegetables, expofed to the direct effect of them; whereas the changes fubfequent to the deftruction of the animal and vegetable texture promote powerfully the growth of plants, and, partly by their immediate efficacy on the plants expofed to their influence, partly by the alterations they produce in the foil, conftitute what is to be confidered as enriching manure (L).

" 5. It fhould be the object of the farmer to give his foil the full benefit of thefe latter changes, decompofitions and recompofitions, which proceed flowly, and continue to go on for years after the manure is lodged in the foil. Even loam or garden-mould is ftill undergoing fome remaining changes of the fame fort; and, by frequently ftirring it, or removing it, and ufing it as a top-dreffing, its fpontaneous changes are fo favoured, that it will yield heavy crops for a time, without frefh manure; or, in other words, it is rendered in fo far a manure itfelf, as it decompofes fafter than in its ordinary and more ftationary ftate, and, in fo doing, nourifhes vegetables more abundantly, or forms new combinations in the adjoining foil, that enable it to do fo.

" It fhould alfo be the object of the farmer, to employ the more early changes, not only to bring forward the fubftances undergoing them into a proper ftate to be committed to the foil, but to accelerate or retard them, fo as to have his manure ready for ufe at the proper feafons, with as little lofs as poffible, from part being too much and part too little decompofed; and alfo to avail himfelf of the activity of thofe changes, to reftore to a ftate of fufficiently rapid fpontaneous decompofition, fuch fubftances in his farm, as, though in a ftate of decay, had become fo ftationary, as to be unfit for manure, without the aid of heat and mixture.

" By attention to the two firft particulars, and the proper ufe of compreffion, ftirring and mixture, the farm dunghill, though formed flowly and of materials in very various ftates of decay, is brought forward in nearly the fame condition. By attention to the latter, manure may, in moft fituations in Scotland, be tripled or quadrupled; *et fimum eft aurum*. On the other hand, by inattention to them, part of the manure is put into the foil unprepared, that is, in a fituation where the texture of the vegetable is ftill entire; and, its decompofition never having been carried far by the heat and mixture of a fermenting mafs, proceeds in the foil fo flowly, that, like ploughed down ftubble, it does not merit the name of manure. Part, again, is apt to be too much rotted, that is, much of it is too nearly approaching to the ftate of garden-mould, whereby much benefit is loft, by the efcape of what had been feparated during the procefs it has undergone, and the good effects on the foil of what remains are lefs durable; for, between folution in water and rapid decompofition from its advanced ftate of rottennefs, it is foon reduced to that of garden-mould; and, in fine, the powers of fermenting vegetable with animal matter, which, when properly employed, are certainly moft efficacious in converting into manure many fubftances that are otherwife very ftationary and flow in their decompofition, are loft to the farmer, fo that he is often reduced to adopt an imperfect and little profitable mode of cultivation, from the want of the manure requifite for a better, though fuch manure may be lying in abundance within his reach, but ufelefs from his ignorance how to prepare it.

" *Peat-mofs* is to be found in confiderable quantities within reach of moft farms in Scotland, particularly in thofe diftricts where outfield land (i. e. land not brought into a regular courfe of cropping and manuring) forms the larger part of the arable land. It confifts of the remains of fhrubs, trees, heath, and other vegetables, which, under the influence of a cold and moift climate, and in wet fituations, have got into a condition almoft ftationary, but much removed from that of the recently dead vegetable, and certainly confiderably diftant from that of garden-mould. It is no longer fufceptible of going of itfelf, though placed in the moft favourable circumftances, into that rapid fermentation, accompanied with heat, which maffes of frefh vegetables experience: But it is ftill a powerful fuel when dried; and, on the other hand, it requires long expofure to the feafons, in a dry fituation, before, without mixture, it is fit for the nourifhing of living vegetables.

" In general, however, there is nothing in the fituation of peat-mofs, or in the changes it has undergone, that leads to think that it has fuffered any thing that unfits it to be prepared for manure. It is no doubt found fometimes mixed with particular mineral fubftances, that may be, for a time, pernicious to vegetation; but, in general, there is no fuch admixture, and, when it does take place, a little patience and attention will be fufficient to cure the evil. In the ordinary cafe, the only fubftances found in peat that may be unfavourable to vegetation, in fo far at leaft as tending to keep it ftationary and prevent its rotting, are two, and both abounding in frefh vegetables of the forts of which mofs is chiefly compofed: Thefe are, gallic acid, and the aftringent principle, or tan; and as thefe are got the better of in frefh vegetables by the hot fermentation to which they are fubject, fo as to leave the general mafs of the fubftances to which they belonged properly prepared manure, there is no reafon to fuppofe, that the fame may not be accomplifhed with the acid and tan of peat. Again, the powers of peat as a fuel, and of afhes of peat as a manure, ought to convince every perfon, that the material and more effential parts of the dead vegetable, for the formation of

(L) Hot fermenting dung partakes of both forts of fermentation.

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of manure, remain entire in peat. Here the inflammable oils and carbonaceous matter which abound in the fresh vegetable, and the latter of which also abounds in garden-mould, remain entire; the soot and ashes, too, which are the results of the inflammation of each, seem to be nearly equally fertilizing; and, in short, little seems to be lost in peat but the effects of the first fermentation in preparing the matter to undergo its future changes with the rapidity requisite to constitute manure. Besides, the soil produced from peat-earth, by exposure for a course of years, seems not to be sensibly different from that obtained from dung in the same way. Both are deficient in firmness of texture; but are very prolific when mixed with clays, sands, and calcareous earths, in due proportion.

"From considering the preceding circumstances, and from trying what substances operated on tan, and on the acid found in peat-moss, it was determined to subject it to the influence of different sorts of fermenting dung, with due attention to the proportions used, and to the effects of the different preparations; and the following is the direction, which an experience of six crops recommends to practice.

"Let the peat-moss, of which compost is to be formed, be thrown out of the pit for some weeks or months, in order to lose its redundant moisture. By this means, it is rendered the lighter to carry, and less compact and weighty, when made up with fresh dung, for fermentation; and accordingly less dung is required for the purpose, than if the preparation is made with peat taken recently from the pit.

"Take the peat-moss to a dry spot, convenient for constructing a dunghill, to serve the field to be manured. Lay it in two rows, and dung in a row betwixt them. The dung thus lies on the area of the compost-dunghill, and the rows of peat should be near enough each other, that workmen, in making up the compost, may be able to throw them together by the spade, without wheeling. In making up, let the workmen begin at one end. Lay a bottom of peat, 6 inches deep, and 15 feet wide, if the ground admit of it (M). Then lay about 10 inches of dung above the peat; then about 6 inches of peat; then four or five of dung, and then six more of peat; then another thin layer of dung; and then cover it over with peats at the end where it was begun, at the two sides, and above. It should not be raised above 4 feet, or $4\frac{1}{2}$ feet high, otherwise it is apt to press too heavily on the under part, and check the fermentation. When a beginning is thus made, the workmen will proceed working backwards, and adding to the column of compost, as they are furnished with the three rows of materials, directed to be laid down for them. They must take care not to tread on the compost, or render it too compact; and of consequence, in proportion as the peat is wet, it should be made up in lumps, and not much broken.

"In mild weather, seven cart-load of common farm-dung, tolerably fresh made, is sufficient for 21 cart-loads of peat-moss; but in cold weather, a larger proportion of dung is desirable. To every 28 carts of the compost, when made up, it is of use to throw on above it a cart-load of ashes, either made from coal, peat, or wood; or if these cannot be had, half the quantity of slaked lime may be used, the more finely powdered the better. But these additions are nowise essential to the general success of the compost.

"The dung to be used should either have been recently made, or kept fresh by compression; as, by the treading of cattle or swine, or by carts passing over it. And if there is little or no litter in it, a smaller quantity will serve, provided any spongy vegetable matter is added at making up the compost, as fresh weeds, the rubbish of a stack-yard, potato-shaws, sawings of timber, &c. And as some sorts of dung, even when fresh, are much more advanced in decomposition than others, it is material to attend to this; for a much less proportion of such dung, as is less advanced, will serve for the compost, provided care is taken to keep the mass sufficiently open, either by a mixture of the above-mentioned substances, or, if these are wanting, by adding the moss piece-meal, that is, first mixing it up in the usual proportion of three to one of dung, and then, after a time, adding an equal quantity, more or less, of moss. The dung of this character, of greatest quantity, is shamble-dung, with which, under the above precautions, six times the quantity of moss, or more, may be prepared. The same holds as to pigeon-dung, and other fowl-dung; and to a certain extent, also, as to that which is collected from towns, and made by animals that feed on grains, refuse of distilleries, &c.

"The compost, after it is made up, gets into a general heat, sooner or later, according to the weather, and the condition of the dung: in summer, in ten days or sooner; in winter, not perhaps for many weeks, if the cold is severe. It always, however, has been found to come on at last; and in summer, it sometimes rises so high, as to be mischievous, by consuming the materials, (fire-fanging). In that season, a stick should be kept in it in different parts, to pull out and feel now and then: for if it approaches to blood-heat, it should either be watered, or turned over; and on such an occasion, advantage may be taken to mix it with a little fresh moss. The heat subsides after a time, and with great variety, according to the weather, the dung, and the perfection of the making up of the compost; which then should be allowed to remain untouched, till within three weeks of using, when it should be turned over, upside down, and outside in, and all lumps broken: then it comes into a second heat; but soon cools, and should be taken out for use. In this state, the whole, except bits of the old decayed wood, appears a black free mass, and spreads like garden-mould. Use it, weight for weight, as farm-yard dung; and it will be found, in a course of cropping, fully to stand the comparison.

"The addition recommended of ashes or lime, is thought to favour the general perfection of the preparation, and to hasten the second heat. The lime laid on above the dunghill, as directed, is rendered mild by the vapours that escape during the first heat.

"Compost, made up before January, has hitherto been

(M) This alludes to the propriety, in clay lands, of suiting the dunghill to the breadth of a single *ridge*, free of each furrow.

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been in good order for the ſpring-crops; but this may not happen in a long froſt. In ſummer, it is ready in eight or ten weeks; and if there is an anxiety to have it ſoon prepared, the addition of aſhes, or of a little lime-rubbiſh of old buildings, or of lime, ſlaked with foul water, applied to the dung uſed in making up, will quicken the proceſs conſiderably.

"Lime has been mixed previouſly with the peat; but the compoſt prepared with that mixture, or with the ſimple peat, ſeemed to produce equally good crops. All the land, however, that it has been tried on, has been limed more or leſs within theſe 25 years.

"Peat prepared with lime alone, has not been found to anſwer as a good manure. In one inſtance, viz. on a bit of fallow ſown with wheat, it was manifeſtly pernicious. Neither with cow-water alone is it prepared, unleſs by lying immerſed in a pool of it for a long time, when it turns into a ſort of ſleetch, which makes an excellent top-dreſſing. Something of the ſame ſort happens with ſoap-ſuds, and water of common ſhores, &c. Lime-water was not found to unite with the tan in peat, nor was urine (N). Peat made up with ſea-weed gets into heat, and the peat ſeems to undergo the ſame change as when prepared with dung. But the effect of this preparation on crops has not yet been experienced. Peat has alſo been expoſed to the fumes of a putrefying carcaſe. In one inſtance the peat proved a manure; but much weaker than when prepared with dung. There, however, the proportion uſed was very large to the carcaſe. Other trials are making, where the proportion is leſs, and with, or without, the addition of aſhes, lime, &c. In all theſe caſes, there can be no ſenſible heat. Peat, heated and rendered friable by the action of the living principle of turnips in growing, was not found entitled, when uſed as a top-dreſſing, to the character of manure. It had been made up in the view of preſerving the turnips during froſt. But the turnips ſprung, and the maſs heated. The turnips were taken out and the peat afterwards uſed as a top-dreſſing. Peat is now under trial, as preparing with turnips and freſh weeds, in fermentation, without the admixture of any animalized matters.

"It is ſaid that dry peat-earth is uſed as a manure in ſome parts of England. But unleſs in chalky ſoils, or others where there may be a great want of carbonaceous matter, it is much doubted whether it could be uſed with any ſenſible advantage. Peat-aſhes were found to raiſe turnips, but to have no ſenſible effect on the next crop.

"The quantity of the compoſt uſed per acre, has varied conſiderably, according to the richneſs of the ſoil manured, and the condition in which it is at manuring, and the ſeaſon in which the manure is applied. From 23 to 35 cart-load, by two horſes each, is about what has been given; the leſſer to fallows and ground in good tilth, and the larger when to be ploughed in with the ſward of poor land; and the intermediate quantities, with tares, peas, potatoes, &c.; and it has in moſt caſes undergone comparative trials with different ſorts of common dung.

"It may be proper to add, that too much attention cannot be paid to the proper preparation of the ground for the reception of manure. It ſhould be clean, pretty dry at the application, and well mixed and friable. Much of the manure applied is otherwiſe loſt, whether lime, dung, or compoſt. The additional quantities recommended when the land is coarſe, is juſt ſo much that would have been ſaved by better cultivation. Common farmers are little aware of this. They might ſave at leaſt half their lime, did they lay it on in powder (O), and on fallows, only harrowing it, and letting it wait for a ſhower before it is ploughed in; and perhaps not much leſs of their dung. It is aſtoniſhing what a viſible effect is produced on land properly mixed by a fallow, from the addition of only a very ſmall quantity of properly prepared dung or compoſt. Both its texture and colour undergo a very ſenſible change, which cannot be accounted for, except from the extrication of ſubſtances from the decompoſing manure, (probably from its ſpontaneous tendency to decompoſe being aided by the chemical action of various matters in a ſoil ſo prepared): And from theſe ſubſtances operating in the ſoil, numberleſs compoſitions and decompoſitions, or tendencies to them, take place, from the various elective attractions of the different parts of which it is compoſed. It is obvious, that an immenſely greater proportion of manure muſt be required to produce even a little of this, where the ſoil is coarſe or lumpy, or conſolidated by wetneſs, than when put into a ſituation favourable to the reciprocal action of the various ſubſtances contained in it, a variety and an admixture formed by nature in perfection in the more favoured ſoils, (as in the bottom of drained lakes, haughs, Delta ground), and which it is the buſineſs of the ſkilful and induſtrious farmer to form or make compenſation for the want of, by judicious manuring, where nature has been leſs bountiful of her gifts.

"It was meant to have given a detailed account of many of the experiments that have been made, whether in Agriculture or Chemiſtry. But as theſe are ſtill going on, and the practical reſults have attracted ſome attention, and prompted imitation by neighbours and acquaintance, ſo that manuſcript directions have been often applied for and obtained, it has been preferred to print, in the mean time, this ſhort account of the buſineſs, diveſted of ſcientific language, and ſuited to the peruſal of any practical huſbandman. It was indeed felt as a degree of wrong, not to take ſome ſteps to make it public, as ſoon as the certainty of ſucceſs warranted. And both the power and the duration

(N) Tan combines with animal gelly, and loſes its aſtringency. The animalized matter, extricated in fermenting dung, has probably this effect on the tan in peat, as well as to render the acid innocent. As vegetable matters ſeem in general to contain the ingredients of, and often ſomewhat ſimilar to, animal gluten, it is poſſible that the fermentation of freſh vegetables alone may prove ſufficient to prepare the peat to rot in the ſoil expeditiouſly; but it is certainly deſirable to uſe alſo animalized matter for this purpoſe.

(O) This they may, though driven in winter, and drowned in the heaps by rains. They have only to turn it over with a very ſmall additional quantity of new burnt ſhells when they come to uſe it.

tion of the manure have now ſtood the teſt of a great variety of trials, on a conſiderable extent of ground, and of much diverſity of ſoil, continued without intermiſſion during the laſt ſix years. Hitherto it has been found equal, and indeed preferable, to common farm-yard dung, for the firſt three years, and decidedly to ſurpaſs it afterwards. It has been conjectured, from the appearance and effects of the compoſt, that its parts are leſs volatile and ſoluble than thoſe of dung; but that it yields to the crop what is requiſite, by the action of the living fibres of vegetables; and in this way waſtes ſlower, and laſts longer. Whatever be in this, nothing has appeared more remarkable, than its ſuperiority in maintaining (for four and five years) freſh and nouriſhing the paſture of thin clays, that had been laid down with it, and in making them yield well when again ploughed, and that without any top-dreſſing, or new manure of any ſort. Employed in this way, the effect of common dung is ſoon over, the ſoil becoming conſolidated, and the paſture ſtunted; and hence ſuch ſoils have not uſually been cultivated with advantage, except by tillage, and by the aid of quantities of manure, got by purchaſe, and much beyond the produce of the farm-yard. It is believed that the foregoing directions will, if practiſed, prove beneficial to every farmer who has acceſs to peat-moſs within a moderate diſtance; but it is to the farmers of the ſoils now mentioned, and of hungry gravels, to whom they would be found particularly valuable.

"Let it be obſerved, that the object in making up the compoſt is to form as large a hot-bed as the quantity of dung employed admits of, and then to ſurround it on all ſides, ſo as to have the whole benefit of the heat and effluvia. Peat, as dry as garden-mould, in ſeed-time, may be mixed with the dung, ſo as to double the volume and more, and nearly triple the weight, and inſtead of hurting the heat prolong it. Workmen muſt begin with uſing layers; but, when accuſtomed to the juſt proportions, if they are furniſhed with peat moderately dry, and dung not loſt in litter, they throw it up together as a mixed maſs; and they improve in the art, ſo as to make a leſs proportion of dung ſerve for the preparation."

475 Of the more common kinds of manure.

With regard to the other kinds of manure commonly in uſe in this country, their efficacy is well known; the only difficulty is to procure them in ſufficient quantity.—In ſuch lands as lie near the ſea, ſea-weeds offer an unlimited quantity of excellent manure. In the neighbourhood of rivers, the weeds with which they abound offer likewiſe an excellent manure in plenty. Oil-cake, malt-coombs, the refuſe of ſlaughter-houſes, &c. all are excellent where they can be got: but the ſituations which afford theſe are comparatively few; ſo that in moſt caſes the farmer muſt depend much on his own ingenuity and induſtry for raiſing a ſufficient quantity of dung to anſwer his purpoſes; and the methods taken for this purpoſe vary according to the ſituation of different places, or according to the fancy of the huſbandman.

476 Manures uſed in Norfolk.

In all countries where chalk, marl, or lime are to be had, they are certainly to be employed in their proper departments; but beſides theſe, *dung*, properly ſo called, mixed with earth or putrid animal and vegetable ſubſtances, everywhere conſtitutes a principal part of the manure. In Norfolk, Mr Marſhall tells us, that the *quality* of dung is attended to with greater preciſion than in moſt other diſtricts. *Town-muck*, as it is called, is held in moſt eſtimation; and the large towns Norwich and Yarmouth ſupply the neighbouring country. As Yarmouth, however, is a maritime place, and otherwiſe in a manner ſurrounded by marſhes, ſtraw is of courſe a ſcarce and dear article; whence, inſtead of littering their horſes with it, they uſe ſand. As the bed becomes ſoiled or wet, freſh ſand is put on, until the whole is in a manner ſaturated with urine and dung, when it is cleared away, and reckoned muck of ſuch excellent quality, that it is ſent for from a very great diſtance. With regard to other kinds of dung, that from horſes fed upon hay and corn is looked upon to be the beſt; that of fatting cattle the next; while the dung of lean cattle, particularly of cows, is ſuppoſed to be greatly inferior, even though turnips make part of their food. The dung of cattle kept on ſtraw alone is looked upon to be of little or no value; while the muck from trodden ſtraw is by ſome thought to be better than that from the ſtraw which is eaten by the lean ſtock.—Compoſts of dung with earth or marl are very generally uſed.

477 In the midland diſtrict.

In the midland counties of England, Mr Marſhall informs us, the cores of horns cruſhed in a mill have been uſed as manure; though he knows not with what ſucceſs. His only objection is the difficulty of reducing them to powder. Dung is extremely dear in Norfolk; half a guinea being commonly given for a waggon-load driven by five horſes. Great quantities of lime and marl are found in this diſtrict. With regard to the method of raiſing dung in general, perhaps the obſervations of Mr Marſhall upon the management of the Yorkſhire farmers may be equally ſatisfactory with any thing that has yet been publiſhed on the ſubject.

478 Mr Marſhall's directions for raiſing dung.

"The general practice (ſays he) is to pile the dung on the higheſt part of the yard; or, which is ſtill leſs judicious, to let it lie ſcattered about on the ſide of a ſlope, as it were for the purpoſe of diſſipating its virtues. The urine which does not mix with the dung is almoſt invariably led off the neareſt way to the common ſewer, as if it were thought a nuiſance to the premiſes. That which mixes with the dung is of courſe carried to the *midden*, and aſſiſts in the general diſſipation. A yard of *dung*, nine-tenths of which are ſtraw, will diſcharge, even in dry weather, ſome of its more fluid particles; and in rainy weather, is, notwithſtanding the ſtraw, liable to be waſhed away if expoſed on a riſing ground. But how much more liable to waſte is a mixture of dung and urine, with barely a ſufficiency of ſtraw to keep them together? In dry weather the natural oozing is conſiderable; and in a wet ſeaſon every ſhower of rain waſhes it away in quantities. The Norfolk method of bottoming the dung-yard with mould is here indiſpenſably neceſſary to common good management. There is no better manure for graſs-lands than mould ſaturated with the oozing of a dunghill: it gets down quickly among the graſs, and has generally a more viſible effect than the dung itſelf. Under this management the arable land would have the ſelfſame dung it now has; while the graſs-land would have an annual ſupply of riches, which now run to waſte in the ſewers and rivulets. But before a dung-yard can with propriety be bottomed with mould, the bottom

Manures. tom of the yard itself ought to be properly formed. A part of it situated conveniently for carriages to come at, and low enough to receive the entire drainings of the stable, cattle-stalls, and hog-sties, should be hollowed out in the manner of an artificial drinking-pool, with a rim somewhat rising, and with covered drains laid into it from the various sources of liquid manure. During the summer months, at leisure times, and embracing opportunities of back-carriage, fill the hollow nearly full with mould, such as the scourings of ditches, the shovellings of roads, the maiden earth of lanes and waste corners, the coping of stone-quarries, &c. &c. leaving the surface somewhat dished; and within this dish set the dung-pile carefully keeping up a rim of mould round the base of the pile higher than the adjoining surface of the yard; equally to prevent extraneous matter from finding its way into the reservoirs, and to prevent the escape of that which falls within its circuit."

479 Of lime as a manure. The use of lime, as a manure, was formerly mentioned *, and also the principle upon which its value depends. It ought to be used not for the purpose of giving food to the plants, but as a stimulant, tending to bring the soil into activity, by reducing to mould all the dead roots of vegetables with which it may abound. Hence it ought never to be used without dung upon soils that have been exhausted by repeated cropping, and that are in a clean state.

* N° 79, 80, 81.

480 Its operation. However people may differ in other particulars, all agree, that the operation of lime depends on its intimate mixture with the soil; and therefore that the proper time of applying it, is when it is perfectly powdered, and the soil at the same time in the higest degree of pulverization. Lime of itself is absolutely barren; and yet it enriches a barren soil. Neither of the two produces any good effect without the other; and consequently, the more intimately they are mixed, the effect must be the greater.

Hence it follows, that lime ought always to be slaked with a proper quantity of water, because by that means it is reduced the most effectually into powder. Lime left to be slaked by a moist air, or accidental rain, is seldom or never thoroughly reduced into powder, and therefore can never be intimately mixed with the soil. Sometimes an opportunity offers to bring home shell-lime before the ground is ready for it; and it is commonly thrown into a heap without cover, trusting to rain for slaking. The proper way is, to lay the shell-lime in different heaps on the ground where it is to be spread, to reduce these heaps into powder by slaking with water, and to cover the slaked lime with sod, so as to defend it from rain. One, however, should avoid as much as possible the bringing home lime before the ground be ready for it. Where allowed to lie long in a heap, there are two bad consequences: first, lime attracts moisture, even though well covered, and runs into clots, which prevents an intimate mixture; and, next, we know that burnt limestone, whether in shells or in powder, returns gradually into its original state of limestone; and upon that account also, is less capable of being mixed with the soil. And this is verified by a fact, that, after lying long, it is so hard bound together as to require a pick to separate the parts.

For the same reason, it is a bad practice, though common, to let spread lime lie on the surface all winter. The bad effects above mentioned take place here in part: and there is another, that rain washes the lime down to the furrows, and in a hanging field carries the whole away.

As the particles of powdered lime are both small and heavy, they quickly sink to the bottom of the furrow, if care be not taken to prevent it. In that view, it is a rule, that lime be spread and mixed with the soil immediately before sowing, or along with the seed. In this manner of application, there being no occasion to move it till the ground be stirred for a new crop, it has time to incorporate with the soil, and does not readily separate from it. Thus, if turnip-seed is to be sown broad-cast, the lime ought to be laid on immediately before sowing, and harrowed in with the seed. If a crop of drilled turnip or cabbage be intended, the lime ought to be spread immediately before forming in drills. With respect to wheat, the lime ought to be spread immediately before seed-furrowing. If spread more early, before the ground be sufficiently broken, it sinks to the bottom. If a light soil be prepared for barley, the lime ought to be spread after seed-furrowing, and harrowed in with the seed. In a strong soil, it sinks not so readily to the bottom, and therefore, before sowing the barley, the lime ought to be mixed with the soil by a brake. Where moor is summer-fallowed for a crop of oats next year, the lime ought to be laid on immediately before the last ploughing, and braked in as before. It has sufficient time to incorporate with the soil before the land be stirred again. 481 Time of liming.

The quantity to be laid on depends on the nature of the soil. Upon a strong soil, 70 or 80 bolls of shells are not more than sufficient, reckoning four small firlots to the boll, termed *wheat measure;* nor will it be an overdose to lay on 100 bolls. Between 50 and 60 may suffice upon medium soils; and upon the thin or gravelly, between 39 and 40. It is not safe to lay a much greater quantity on such soils. 482 Quantity.

It is common to lime a pasture-field immediately before ploughing. This is an unsafe practice; it is thrown to the bottom of the furrow, from which it is never fully gathered up. The proper time for liming a pasture-field, intended to be taken up for corn, is a year at least, or two, before ploughing. It is washed in by rain among the roots of the plants, and has time to incorporate with the soil. 483 Liming pasture-fields.

Limestone beat small makes an excellent manure; and supplies the want of powdered lime where there is no fuel to burn the limestone. Limestone beat small has not hitherto been much used as a manure; and the proportion between it and powdered lime has not been ascertained. What follows may give some light. Three pounds of raw lime is by burning reduced to two pounds of shell-lime. Yet nothing is expelled by the fire but the air that was in the limestone: the calcareous earth remains entire. *Ergo*, two pounds of shell-lime contain as much calcareous earth as three pounds of raw limestone. Shell-lime of the best quality, when slaked with water, will measure out to thrice the quantity. But as limestone loses none of its bulk by being burnt into shells, it follows, that three bushels of raw limestone contain as much calcareous earth as six bushels of powdered lime; and consequently, if powdered lime- 484 Beat limestone.

lime possess not some virtue above raw limestone, three bushels of the latter beat small should equal as a manure six bushels of the former.

485 Of shell-marl. Shell-marl, as a manure, is managed in every respect like powdered lime; with this only difference, that a fifth or a fourth part more in measure ought to be given. The reason is, that shell-marl is less weighty than lime; and that a boll of it contains less calcareous earth, which is the fructifying part of both.

486 Of clay and stone marls. Clay and stone marls, with respect to husbandry, are the same, though in appearance different.

The goodness of marl depends on the quantity of calcareous earth in it: which has been known to amount to a half or more. It is too expensive if the quantity be less than a third or a fourth part. Good marl is the most substantial of all manures; because it improves the weakest ground to equal the best borough-acres. The low part of Berwickshire, termed *the Merse*, abounds everywhere with this marl; and is the only county in Scotland where it is plenty.

Land ought to be cleared of weeds before marling; and it ought to be smoothed with the brake and harrow, in order that the marl may be equally spread. Marl is a fossil on which no vegetable will grow; its efficacy depends, like that of lime, on its pulverization, and intimate mixture with the soil. Toward the former, alternate drought and moisture contribute greatly, as also frost. Therefore, after being evenly spread, it ought to lie on the surface all winter. In the month of October it may be roused with a brake; which will bring to the surface, and expose to the air and frost all the hard parts, and mix with the soil all that is powdered. In that respect it differs widely from dung and lime, which ought usually to be ploughed into the ground without delay. Oats is a hardy grain, which will answer for height the first crop after marling better than any other; and it will succeed though the marl be not thoroughly mixed with the soil. In that case, the marl ought to be ploughed in with an ebb furrow immediately before sowing, and braked thoroughly. It is ticklish to make wheat the first crop: if sown before winter, frost swells the marl, and is apt to throw the seed out of the ground; if sown in spring, it will suffer more than oats by want of due mixture.

Summer is the proper season for marling; because in that season the marl, being dry, is not only lighter, but is easily reduced to powder. Frost, however, is not improper for marling, especially as in frost there is little opportunity for any other work.

Marl is a heavy body, and sinks to the bottom of the furrow, if indiscreetly ploughed. Therefore the first crop should always have an ebb furrow. During the growing of that crop, the marl has time to incorporate with the soil, and to become a part of it; after which it does not readily separate.

487 Of gypsum as a manure. Of late a new manure has been introduced into some countries. This is gypsum, which is lime united with sulphuric acid. In the eighth volume of the Annals of Agriculture we are informed, that it is commonly used as a manure in Switzerland. In the 10th volume of the same work, Sir Richard Sutton gives some account of an experiment made with it on his estate; but in such an inaccurate manner, that nothing could be determined. "The appearance in general (says he), I think, was rather against the benefit of the plaster, though not decidedly so." He tells us, that its virtues were a subject of debate in Germany. In America this substance seems to have met with more success than in any other country. In the fifth volume of Bath Papers, Mr Kirkpatrick of the Isle of Wight, who had himself visited North America, informs us, that it is much used in the United States, on account of its cheapness and efficacy; though, from what is there stated, we must undoubtedly be led to suppose, that its *efficacy* must be very great before it can be entitled to the praise of *cheapness*. In the first place, it is brought from the hills in the neighbourhood of Paris to Havre de Grace, and from thence exported to America; which of itself must occasion a considerable expence, though the plaster were originally given *gratis*. In the next place, it must be powdered in a stamping mill, and the finer it is powdered so much the better. In the third place, it must be *sown* over the ground to be manured with it. The quantity for grass is six bushels to an acre. It ought to be sown on dry ground in a wet day; and its efficacy is said to last from seven to twelve years. It operates entirely as a top-dressing.

In the 10th volume of the Annals of Agriculture, we have some extracts from a treatise by Mr Powel, president of the Philadelphia Society for encouraging Agriculture, upon the subject of gypsum as a manure; of the efficacy of which he gives the following instances. 1. In October 1786, plaster of Paris was sown in a rainy day upon wheat-stubble without any previous culture. The crop of wheat had scarce been worth reaping, and no kind of grass seed had been sown upon the ground; nevertheless, in the month of June it was covered with a thick mat of white clover, clean and even, from six to eight inches in height. A piece of ground adjoining to this white clover was also sown with gypsum, and exhibited a fine appearance of white and red clover mixed with spear-grass. Some wet ground sown at the same time was not in the least improved.—This anecdote rests entirely on the veracity of an anonymous farmer. 2. Eight bushels of plaster of Paris spread upon two acres and a half of wheat-stubble ground, which the spring before had been sowed with about two pounds of red clover-seed to the acre for pasture, yielded five tons of hay by the middle of June. A small piece of ground of similar quality, but without any plaster, produced only one ton and a half in the same proportion.—Mr Powel concludes in favour of the effects of the plaster upon arable as well as grass land.

Other accounts to the same purpose have been published, though it must also be remarked, that various persons who have made trial of this manure, declare themselves dissatisfied with it; but it does not appear that it has hitherto been at all tried in this part of the island.

When a soil abounds too much in particles of a particular kind, it has been found expedient to mix it with earth of a different character. Hence we are informed in the 12th volume of the Annals of Agriculture, that in Cornwall, large quantities of sea-sand are annually conveyed to the land, and laid upon the soil; a practice which will no doubt have a tendency to ameliorate stiff clays, and to render them more pervious to the roots of plants. With the same view, and also to save fuel, a practice is said to exist in the Netherlands, of baking 488 Of sea-sand as a manure.

Drill or Horse-hoeing Husbandry.

baking up the drofs or culm of coal, and alfo peat-earth, with clay, into lumps or bricks, which when dried in the air, make excellent fuel, and alfo afford an immenfe quantity of valuable afhes to be laid upon the land.

Sect. VIII. *Principles and Operations of the Drill or Horse-hoeing Hufbandry.*

The general properties attributed to the new or drill hufbandry may be reduced to two, viz. the promoting the growth of plants by hoeing, and the faving of feed; both of which are equally profitable to the farmer.

489 Advantages afcribed to horfe-hoeing.

The advantages of tillage before fowing have already been pointed out. In this place we muft confine ourfelves to the utility of tillage after fowing. This kind of tillage is moft generally known by the name of *horfe-hoeing.*

Land fowed with wheat, however well it may be cultivated in autumn, finks in the winter; the particles get nearer together, and the weeds rife; fo that in fpring, the land is nearly in the fame fituation as if it never had been ploughed. This, however, is the feafon when it fhould branch and grow with moft vigour; and confequently ftands moft in need of ploughing or hoeing, to deftroy the weeds, to fupply the roots with frefh earth, and, by dividing anew the particles of the foil, to allow the roots to extend and collect nourifhment.

It is well known, that, in gardens, plants grow with double vigour after being hoed or tranfplanted. If plants growing in arable land could be managed with eafe and fafety in this manner, it is natural to expect, that their growth would be promoted accordingly. Experience fhows, that this is not only practicable, but attended with many advantages.

In the operation of hoeing wheat, though fome of the roots be moved or broken, the plants receive no injury; for this very circumftance makes them fend forth a greater number of roots than formerly, which enlarge their pafture, and confequently augment their growth.

Sickly wheat has often recovered its vigour after a good hoeing, efpecially when performed in weather not very hot or dry.

Wheat, and fuch grain as is fown before winter, requires hoeing more than oats, barley, or other grain fown in the fpring; for, if the land has been well ploughed before the fowing of fpring corn, it neither has time to harden, nor to produce many weeds, not having been expofed to the winter's fnow and rain.

Of Sowing.

490 Method of fowing in the drill hufbandry.

As in the practice of the new hufbandry, plants grow with greater vigour than by the old method, the land fhould be fowed thinner. It is this principle of the new hufbandry that has been chiefly objected to; for, upon obferving the land occupied by a fmall number of plants, people are apt to look upon all the vacant fpace as loft. But this prejudice will foon be removed, when it is confidered, that in the beft land cultivated in the common method, and fown very thick, each feed produces but one or two ears; that, in the fame land fown thinner, every feed produces two or three three ears; and that a fingle feed fometimes produces 18 or 21 ears.

In the common method, as there are many more plants than can find fufficient nourifhment, and as it is impoffible to affift them by hoeing, numbers die before they attain maturity; the greateft part remain fickly and drooping; and thus part of the feed is loft. On the contrary, in the new method, all the plants have as much food as they require; and as they are, from time to time, affifted by hoeing, they become fo vigorous as to equal in their production the numerous but fickly plants cultivated in the common method.

Of Hoeing.

The new hufbandry is abfolutely impracticable in lands that are not eafily ploughed. Attempting to cultivate land according to this hufbandry, without attending to this circumftance, that it is practicable in no land excepting fuch as have already been brought into good tilth by the old method, has gone far to make it contemptible in many places.

When a field is in good tilth, it fhould be fown fo thin as to leave fufficient room for the plants to extend their roots. After being well ploughed and harrowed, it muft be divided into rows, at the diftance of thirty inches from one another. On the fides of each of thefe rows, two rows of wheat muft be fowed fix inches diftant from each other. By this means there will be an interval of two feet wide betwixt the rows, and every plant will have room enough to extend its roots, and to fupply it with food. The intervals will likewife be fufficient for allowing the earth to be hoed or tilled without injuring the plants in the rows.

The firft hoeing, which fhould be given before the winter, is intended to drain away the wet, and to difpofe the earth to be mellowed by the frofts. Thefe two ends will be anfwered by drawing two fmall furrows at a little diftance from the rows, and throwing the earth taken from the furrows into the middle of the intervals. This firft hoeing fhould be given when the wheat is in leaf. 491 The different hoeings.

The fecond hoeing, which is intended to make the plants branch, fhould be given after the hard frofts are over. To do this with advantage, after ftirring the earth a little near the rows, the earth which was thrown into the middle of the intervals fhould be turned back into the furrows. This earth, having been mellowed by the winter, fupplies the plants with excellent food, and makes the roots extend.

The third hoeing, which is intended to invigorate the ftalk, fhould be given when the ears of the corn begin to fhow themfelves. This hoeing may, however, be very flight.

But the laft hoeing is of the greateft importance, as it enlarges the grain, and makes the ears fill at their extremities. This hoeing fhould be given when the wheat is in bloom; a furrow muft be drawn in the middle of the interval, and the earth thrown to the right and left on the foot of the plants. This fupports the plants, prevents them from being laid, and prepares the ground for the next fowing, as the feed is then to be put in the middle of the ground that formed the intervals.

The beft feafon for hoeing is two or three days after rain, or fo foon after rain as the foil will quit the inftrument in hoeing. Light dry foils may be hoed almoft at any time, but this is far from being the cafe with

ftrong

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ftrong clay foils; the feafon for hoeing fuch is frequently fhort and precarious; every opportunity therefore fhould be carefully watched, and eagerly embraced. The two extremes of wet and dry, are great enemies to vegetation in ftrong clay foils. There is a period between the time of clay foils running together, fo as to puddle by fuperfluous wet, and the time of their caking by drought, in which they are perfectly manageable. This is the juncture for hoeing; and fo much land as fhall be thus feafonably hoed, will not cake or cruft upon the furface, as it otherwife would have done, till it has been foaked or drenched again with rain; in which cafe the hoeing is to be repeated as foon as the foil will quit the inftrument, and as often as neceffary; by which time the growing crop will begin to cover the ground, fo as to act as a fcreen to the furface of the land againft the intenfe heat of the fun, and thereby prevent, in a great meafure, the bad effects of the foil's caking in dry weather.

By this fucceffive tillage, or hoeing, good crops will be obtained, provided the weather is not very unfavourable.

But as ftrong vigorous plants are long before they arrive at maturity, corn raifed in the new way is later in ripening than any other, and muft therefore be fown earlier.

In order to prepare the intervals for fowing again, fome well-rotted dung may be laid in the deep furrows made in the middle of the intervals; and this dung muft be covered with the earth that was before thrown towards the rows of wheat. But, if the land does not require mending, the deep furrow is filled without any dung. This operation fhould be performed immediately after harveft, that there may be time to give the land a flight ftirring before the rows are fowed; which fhould occupy the middle of the fpace which formed the intervals during the laft crop. The intervals of the fecond year take up the fpace occupied by the ftubble of the firft.

Suppofing dung to be neceffary, which is denied by many, a very fmall quantity is fufficient; a fingle layer, put in the bottom of each furrow, will be enough.

Description of the Instruments commonly ufed in the New Husbandry.

492 Inftruments defcribed. Plate X.

Fig. 1. is a marking plough. The principal ufe of this plough is to ftraight and regulate the ridges. The firft line is traced by the eye, by means of three poles, placed in a ftraight line. The plough draws the firft furrow in the direction of this line; and at the fame time, with the tooth A, fixed in the block of wood near the end of the crofs-pole or flider BB, marks the breadth of the ridge at the diftance intended. The ploughman next traces the fecond line or rutt made by the tooth, and draws a fmall furrow along it; and continues in this manner till the whole field is laid out in ftraight and equidiftant ridges.

Fig. 2. is a plough for breaking up ley, or turning up the bottom of land when greatly exhaufted. By its conftruction, the width and depth of the furrows can be regulated to a greater certainty than by any other hitherto known in this country. Its appearance is heavy: but two horfes are fufficient to plough with it in ordinary free land; and only four are neceffary in the ftiffeft clay-foils. This plough is likewife eafily held and tempered. A, is the fword fixed in the fizers B, which runs through a mortoife E, at the end of the beam C, and regulates the depth of the furrow by raifing or depreffing the beam; it is fixed by putting the pin D through the beam and fword, and is moveable at E.

Plate X.

Fig. 3. is a jointed brake-harrow with 24 teeth, fhaped like coulters, and ftanding at about an angle of 80 degrees. By this inftrument the land is finely pulverized, and prepared for receiving the feed from the drill. It requires four horfes in ftiff, and two in open land. This harrow is likewife ufed for levelling the ridges; which is done by preffing it down by the handles where the ridge is high, and raifing it up when low.

Fig. 4. is an angular weeding harrow, which may follow the brake when neceffary. The feven hindmoft teeth fhould ftand at a more acute angle than the reft, in order to collect the weeds, which the holder can drop at pleafure, by raifing the hinder part, which is fixed to the body of the harrow by two joints.

Fig. 5. is a pair of harrows with fhafts. This harrow is ufed for covering the feed in the drills, the horfe going in the furrow.

Fig. 6. is a drill-plough, conftructed in fuch a manner as to fow at once two rows of beans, peafe, or wheat. This machine is eafily wrought by two horfes. A, is the happer for containing the feed; B, circular boxes for receiving the feed from the happer; CC, two fquare boxes which receive the feed from fmall holes in the circular boxes, as they turn round; and laft of all, the feed is dropped into the drills through holes in the fquare boxes, behind the coulters D. The cylinder E follows, which, together with the wheel F, regulates the depth of the coulters, and covers the feed; the harrow G comes behind all, and covers the feed more completely. HH, two fliders, which, when drawn out, prevent the feed from falling into the boxes; and, I, is a ketch which holds the rungs, and prevents the boxes from turning, and lofing feed at the ends of the ridges.

Fig. 7. is a fingle hoe-plough of a very fimple conftruction, by which the earth in the intervals is ftirred and laid up on both fides to the roots of the plants, and at the fame time the weeds are deftroyed. AA the mouldboards, which may be raifed or depreffed at pleafure, according as the farmer wants to throw the earth higher or lower upon the roots.

Plate IX.

Fig. 2. is a drill-rake for peafe. This inftrument, which is chiefly calculated for fmall inclofures of light grounds, is a fort of ftrong plough rake, with four large teeth at *a*, *a*, *b*, *b*, a little incurvated. The diftance from *a* to *a*, and from *b* to *b*, is nine inches. The interval between the two inner teeth, *a* and *b*, is three feet fix inches, which allows fufficient room for the hole-plough to move in. To the piece of timber *c c*, forming the head of the rake, are fixed the handles *d*, and the beam *e* to which the horfe is faftened. When this inftrument is drawn over a piece of land made thoroughly fine, and the man who holds it bears upon the handles, four furrows, *f*, *g*, *h*, *i*, will be formed, at the diftances determined by the conftruction of the inftrument. Thefe diftances may be accurately preferved, provided that the teeth *a a* return when the ploughman

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man comes back, after having ploughed one turn, in two of the channels formed before, marked *b b*: thus all the furrows in the field will be traced with the ſame regularity. When the ground is thus formed into drills, the peaſe may be ſcattered by a ſingle motion of the hand at a certain diſtance from one another into the channels, and then covered with the flat part of a hand-rake, and preſſed down gently. This inſtrument is ſo ſimple, that any workman may eaſily make or repair it.

Plate XI.

On Plate XI. is delineated a patent drill machine, lately invented by the Reverend James Cooke of Heaton-Norris near Mancheſter. A, the upper part of the ſeed-box. B, the lower part of the ſame box. C, a moveable partition, with a lever, by which the grain or ſeed is let fall at pleaſure from the upper to the lower part of the ſeed-box, from whence it is taken up by cups or ladles applied to the cylinder D, and dropped into the funnel E, and conveyed thereby into the furrow or drill made in the land by the coulter F, and covered by the rake or harrow G. H, a lever, by which the wheel I is lifted out of generation with the wheel K, to prevent the grain or ſeed being ſcattered upon the ground, while the machine is turning round at the end of the land, by which the harrow G is alſo lifted from the ground at the ſame time, and by the ſame motion, by means of the crank, and the horizontal lever *b b*. L, a ſliding lever, with a weight upon it, by means of which the depth of the furrows or drills, and conſequently the depth that the grain or ſeed will be depoſited in the land, may be eaſily aſcertained. M, a ſcrew in the coulter beam, by turning of which the ſeed-box B is elevated or depreſſed, in order to prevent the grain or ſeed being cruſhed or bruiſed by the revolution of the cups or ladles. Fig. 13. a rake with iron teeth, to be applied to the under ſide of the rails of the machine, with ſtapples and ſcrew nuts at *n n*, by which many uſeful purpoſes are anſwered, *viz.* in accumulating cuitch or hay into rows, and as a ſcarificator for young crops of wheat in the ſpring, or to be uſed upon a fallow; in which caſe, the ſeed-box, the ladle cylinder, the coulters, the funnels, and harrows, are all taken away.

This ſide view of the machine is repreſented, for the ſake of perſpicuity, with one ſeed-box only, one coulter, one funnel, one harrow, &c. whereas a complete machine is furniſhed with five coulters, five harrows, ſeven funnels, a ſeed-box in eight partitions, &c. with ladles of different ſizes, for different ſorts of grain and ſeeds.

Theſe machines (with five coulters ſixteen guineas, with four coulters fifteen guineas), equally excel in ſetting or planting all ſorts of grain and ſeeds, even carrot-ſeed, to exactneſs, after the rate of from eight to ten chain acres per day, with one man, a boy, and two horſes. They depoſite the grain or ſeed in any given quantity from one peck to three buſhels per acre, regularly and uniformly, and that without grinding or bruiſing the ſeed, and at any given depth, from half an inch to half a dozen inches, in rows at the diſtance of twelve, ſixteen and twenty-four inches, or any other diſtance. They are equally uſeful on all lands, are durable, eaſy to manage, and by no means ſubject to be put out of repair.

The ladle cylinder D is furniſhed with cups or ladles of four different ſizes for different ſorts of grain or ſeeds, which may be diſtinguiſhed by the numbers 1, 2, 3, 4.—N° 1. (the ſmalleſt ſize) is calculated for turnip-ſeed, clover-ſeed, cole-ſeed, rape, &c. and will ſow ſomething more than one pound per ſtatute acre. N° 2. for wheat, rye, hemp, flax, &c. and will ſow ſomething more than one buſhel per acre. N° 3. for barley; and will ſow one buſhel and a half per acre. N° 4. for beans, oats, peaſe, vetches, &c. and will ſow two buſhels per acre.

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Notwithſtanding the above ſpecified quantities of grain or ſeeds, a greater or leſs quantity of each may be ſown at pleaſure, by ſtopping up with a little clay or by adding a few ladles to each reſpective box. The grain or ſeeds intended to be ſown, muſt be put in thoſe boxes, to which the cups or ladles as above deſcribed reſpectively belong, an equal quantity into each box, and all the other boxes empty. The ladle cylinder may be reverſed, or turned end for end at pleaſure, for different ſorts of grain, &c.

For ſowing beans, oats, peaſe, &c. with a five-coulter machine, four large ladles muſt occaſionally be applied at equal diſtances round thoſe parts of the cylinder which ſubtend the two end boxes. And for ſowing barley, eight large ones muſt be applied as above; or four ladles, N° 2. to each of the wheat boxes. Theſe additional ladles are fixed on the cylinder with nails, or taken off in a few minutes; but for ſowing with a four coulter machine, the above alterations are not neceſſary.

The funnels are applied to their reſpective places by correſponding numbers. Care ſhould be taken, that the points of the funnels ſtand directly behind the backs of the coulters, which is done by wedges being applied to one ſide or other of the coulters, at the time they are fixed in their reſpective places.

The machine being thus put together, which is readily and expeditiouſly done, as no ſeparate part will coincide with any other but that to which it reſpectively belongs, and an equal quantity of grain or ſeed in each of the reſpective boxes, the land alſo being previouſly ploughed and harrowed once or ſo in a place to level the ſurface; but if the land be very rough, a roller will beſt anſwer that purpoſe, whenever the land is dry enough to admit of it; and upon ſtrong clays, a ſpiked roller is ſometimes neceſſary to reduce the ſize of the large dry clods; which being done, the driver ſhould walk down the furrow or edge of the land, and having hold of the laſt horſe's head with his hand, he will readily keep him in ſuch a direction, as will bring the outſide coulter of the machine within three or four inches of the edges of the land or ridge, at which uniform extent, he ſhould keep his arm till he comes to the end of the land; where having turned round, he muſt come to the other ſide of his horſes, and walking upon the laſt outſide drill, having hold of the horſe's head with his hand as before, he will readily keep the machine in ſuch a direction, as will ſtrike the ſucceeding drill at ſuch a diſtance from the laſt outſide one, or that he walks upon, as the coulters are diſtant from each other.

The perſon who attends the machine ſhould put down the lever H ſoon enough at the end of the land, that the cups or ladles may have time to fill, before he begins to ſow; and at the end of the land, he muſt ap-

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ply his right hand to the middle of the rail between the handles, by which he will keep the coulters in the ground, while he is lifting up the lever H with his left hand, to prevent the grain being fcattered upon the headland, while the machine is turning round; this he will do with great eafe, by continuing his right hand upon the rail between the handles, and applying his left arm under the left handle, in order to lift the coulters out of the ground while the machine is turning round.

If there be any difficulty in ufing the machine, it confifts in driving it ftraight. As to the perfon who attends the machine, he cannot poffibly commit any errors, except fuch as are wilful, particularly as he fees at one view the whole procefs of the bufinefs, viz. that the coulters make the drills of a proper depth; that the funnels continue open to convey the grain or feed into the drills; that the rakes or harrows cover the grain fufficiently; and when feed is wanting in the lower boxes B, which he cannot avoid feeing, he readily fupplies them from the upper boxes A, by applying his hand, as the machine goes along, to the lever C. The lower boxes B fhould not be fuffered to become empty before they are fupplied with feed, but fhould be kept nearly full, or within an inch or fo of the edge of the box.

If chalk lines are made acrofs the backs of the coulters, at fuch a diftance from the ends as the feed fhould be depofited in the ground (viz. about two inches for wheat, and from two to three for fpring corn), the perfon that attends the machine will be better able to afcertain the depth the feed fhould be depofited in the drills, by obferving, as the machine goes along, whether the chalk lines are above or below the furface of the land; if above, a proper weight muft be applied to the lever L, which will force the coulters into the ground; if below, the lever L and weight muft be reverfed, which will prevent their finking too deep.

In different parts of the kingdom, lands or ridges are of different fizes; where the machine is too wide for the land, one or more funnels may occafionally be ftopped with a little loofe paper, and the feed received into fuch funnel returned at the end of the land, or fooner if required, into the upper feed-box. But for regularity and expedition, lands confifting of fo many feet wide from outfide to outfide, as the machine contains coulters, when fixed at twelve inches diftance, or twice or three times the number, &c. are beft calculated for the machine. In wet foils or ftrong clays, lands or ridges of the width of the machine, and in dry foils, of twice the width, are recommended. For fowing of narrow high-ridged lands, the outfide coulters fhould be let down, and the middle ones raifed, fo that the points of the coulters may form the fame curve that the land or ridge forms. And the loofe foil harrowed down into the furrows fhould be returned to the edges of the lands or ridges from whence it came, by a double mouldboard or other plough, whether the land be wet or dry.

Clover or other leys, intended to be fown by the machine, fhould be ploughed a deep ftrong furrow and well harrowed, in order to level the furface, and to get as much loofe foil as poffible for the coulters to work in; and when fown, if any of the feed appears in the drills uncovered by reafon of the ftiff texture of the foil, or toughnefs of the roots, a light harrow may be taken over the land, once in a place, which will effectually cover the feed, without difplacing it all in the drills. For fowing leys, a confiderable weight muft be applied to the lever L, to force the coulters into the ground; and a fet of wrought-iron coulters, well fteeled, and made fharp at the front edge and bottom, are recommended; they will pervade the foil more readily, confequently require lefs draught, and expedite bufinefs more than adequate to the additional expence.

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For every half acre of land intended to be fown by the machine with the feed of that very valuable root (carrot), one bufhel of faw-duft, and one pound of carrot-feed, fhould be provided; the faw-duft fhould be made dry, and fifted to take out all the lumps and chips, and divided into eight equal parts or heaps; the carrot-feed fhould likewife be dried, and well rubbed between the hands, to take off the beards, fo that it may feparate readily; and being divided into eight equal parts or heaps, one part of the carrot-feed muft be well mixed with one part of the faw-duft, and fo on, till all the parts of carrot-feed and faw-duft are well mixed and incorporated together; in which ftate it may be fown very regularly in drills at twelve inches diftance, by the cups or ladles N° 2. Carrot-feed refembling faw-duft very much in its fize, roughnefs, weight, adhefion, &c. will remain mixed as above during the fowing; a ladleful of faw-duft will, upon an average, contain three or four carrot-feeds, by which means the carrot-feed cannot be otherwife than regular in the drills. In attempting to depofite fmall feeds near the furface, it may fo happen that fome of the feeds may not be covered with foil; in which cafe, a light roller may be drawn over the land after the feed is fown, which will not only cover the feeds, but will alfo, by levelling the furface, prepare the land for an earlier hoeing than could otherwife have taken place.

It has always been found troublefome, fometimes impracticable, to fow any kind of grain or feeds (even broad-caft) in a high wind. This inconvenience is entirely obviated by placing a fcreen of any kind of cloth, or a fack, fupported by two uprights nailed to the fides of the machine, behind the funnels, which will prevent the grain or feed being blown out of its direction in falling from the ladles into the funnels. Small pipes of tin may alfo be put on to the ends of the funnels, to convey the grain or feed fo near the furface of the land, that the higheft wind fhall not be able to interrupt its defcent into the drills.

Refpecting the ufe of the machine, it is frequently remarked by fome people not converfant with the properties of matter and motion, that the foil will clofe after the coulters, before the feed is admitted into the drills. Whereas the very contrary is the cafe; for the velocity of the coulters in paffing through the foil, is fo much greater than the velocity with which the foil clofes up the drills by its own fpontaneous gravity, that the incifions or drills will be conftantly open for three or four inches behind the coulters; by which means, it is morally impoffible (if the points of the funnels ftand directly behind the coulters) that the feed, with the velocity it acquires in falling through the funnels, fhall not be admitted into the drills.

Fig.

Drill or Horse-hoeing Husbandry.

Plate XI.

Fig. 12. is a new constructed simple hand-hoe, by which one man will effectually hoe two chain acres *per* day, earthing up the soil at the same time to the rows of corn or pulse, so as to cause roots to issue from the first joint of the stem, above the surface of the land, which otherwise would never have existed.

This hoe is worked much in the same manner as a common Dutch hoe, or scuffle, is worked in gardens. The handle is elevated or depressed, to suit the size of the person that works it, by means of an iron wedge being respectively applied to the upper or under side of the handle that goes into the socket of the hoe.

The wings or moulding plates of the hoe, which are calculated to earth up the soil to the rows of corn, so as to cause roots to issue from the first joint of the stem above the surface, which otherwise would not have existed, should never be used for the first hoeing, but should always be used for the last hoeing, and used or not used, at the option of the farmer, when any intermediate hoeing is performed.

SUMMARY of the OPERATIONS necessary in executing the NEW HUSBANDRY with the PLOUGH.

493 Summary of the operations.

1. It is indispensably necessary that the farmer be provided with a drill and hoe-plough.

2. The new husbandry may be begun either with the winter or spring corn.

3. The land must be prepared by four good ploughings, given at different times, from the beginning of April to the middle of September.

4. These ploughings must be done in dry weather, to prevent the earth from kneading.

5. The land must be harrowed in the same manner as if it were sowed in the common way.

6. The rows of wheat should be sowed very straight.

7. When the field is not very large, a line must be strained across it, by which a rill may be traced with a hoe for the horse that draws the drill to go in; and when the rows are sown, 50 inches must be left betwixt each rill. But, when the field is large, stakes at five feet distance from each other must be placed at the two ends. The workman must then trace a small furrow with a plough that has no mouldboard, for the horse to go in that draws the drill, directing himself with his eye by the stakes.

8. The sowing should be finished at the end of September, or beginning of October.

9. The furrows must be traced the long way of the land, that as little ground as possible may be lost in headlands.

10. The rows, if it can be done, should run down the slope of the land, that the water may get the easier off.

11. The seed-wheat must be plunged into a tub of lime-water, and stirred, that the light corn may come to the surface and be skimmed off.

12. The seed must be next spread on a floor, and frequently stirred, till it is dry enough to run through the valves of the happer of the drill.

13. To prevent smut, the seed may be put into a ley of ashes and lime.

14. Good old seed-wheat should be chosen in preference to new, as it is found by experience not to be so subject to smut.

15. After the happers of the drill are filled, the horse must go slowly along the furrow that was traced. That a proper quantity of seed may be sown, the aperture of the happer must be suited to the size of the grain.

16. As the drill is seldom well managed at first, the field should be examined after the corn has come up, and the deficiencies be supplied.

17. Upon wet soils or strong clays, wheat should not be deposited more than two inches deep, on any account whatever; nor less than two inches deep on dry soils. From two to three inches is a medium depth for all spring corn. But the exact depth at which grain should be deposited in different soils, from the lightest sand to the strongest clay, is readily ascertained only by observing at what distance under the surface of the land, the secondary or coronal roots are formed in the spring.

18. Stiff lands, that retain the wet, must be stirred or hoed in October. This should be done by opening a furrow in the middle of the intervals, and afterwards filling it up by a furrow drawn on each side, which will raise the earth in the middle of the intervals, and leave two small furrows next the rows, for draining off the water, which is very hurtful to wheat in winter.

19. The next stirring must be given about the end of March, with a light plough. In this stirring the furrows made to drain the rows must be filled up by earth from the middle of the interval.

20. Some time in May, the rows must be evened; which, though troublesome at first, soon becomes easy, as the weeds are soon kept under by tillage.

21. In June, just before the wheat is in bloom, another stirring must be given with the plough. A deep furrow must be made in the middle of the intervals, and the earth thrown upon the sides of the rows.

22. When the wheat is ripe, particular care must be taken, in reaping it, to trample as little as possible on the ploughed land.

23. Soon after the wheat is carried off the field, the intervals must be turned up with the plough, to prepare them for the seed. The great furrow in the middle must not only be filled, but the earth raised as much as possible in the middle of the intervals.

24. In September, the land must be again sowed with a drill, as above directed.

25. In October, the stubble must be turned in for forming the new intervals; and the same management must be observed as directed in the first year.

We pretend not to determine whether the old or new husbandry be preferable in every country. With regard to this point, the climate, the situation of particular land, skill and dexterity in managing the machinery, the comparative expence in raising crops, and many other circumstances must be accurately attended to before a determination can be given.

To give an idea of the arguments by which the drill husbandry was originally supported, we shall here take notice of a comparative view of the old and new methods of culture which was furnished for the editors of Mr Tull's Horse-hoeing Husbandry, by a gentleman who for some years practised both in a country where the soil was light and chalky, like that from which he drew his observations. It is necessary to remark, that in the new husbandry every article is stated at its full value, and the crop of each year is four bushels short of the other; though,

though, in several years experience, it has equalled and generally exceeded those in the neighbourhood in the old way.

"An estimate of the expence and profit of 10 acres of land in 20 years.

494 Comparative view of the expence and profits of the old and new husbandry.

I. In the old way.

	L.	s.	d.	L.	s.	d.
First year, for wheat, costs 33l. 5s. viz.						
First ploughing, at 6s. per acre	3	0	0			
Second and third ditto, at 8s. per acre -	4	0	0			
Manure, 30s. per acre	15	0	0	22	0	0
Two harrowings, and sowing, at 2s. 6d. per acre -	1	5	0			
Seed, three bushels per acre, at 4s. per bushel -	6	0	0			
Weeding, at 2s. per acre,	1	0	0			
Reaping, binding, and carrying, at 6s. per acre -	3	0	0	11	5	0
Second year, for barley, costs 11l. 6s. 8d. viz.						
Once ploughing at 6s. per acre - -	3	0	0			
Harrowing and sowing, at 1s. 6d. per acre -	0	15	0			
Weeding, at 1s. per acre	0	10	0			
Seed, four bushels per acre, at 2s. per bushel -	4	0	0			
Cutting, raking, and carrying, at 3s. 2d. per acre -	1	11	8			
Grass-seeds, at 3s. per acre	1	10	0	11	6	8
				44	11	8
Third and fourth years, lying in grass, cost nothing: so that the expence of ten acres in four years comes to 44l. 11s. 8d. and in twenty years to -				222	18	4
First year's produce is half a load of wheat per acre, at 7l.	35	0	0			
Second year's produce is two quarters of barley per acre, at 1l. - -	20	0	0			
Third and fourth years grass is valued at 1l. 10s. per acre	15	0	0			
So that the produce of ten acres in four years is	70	0	0			
And in twenty years it will be				350	0	0
Deduct the expence, and there remains clear profit on ten acres in twenty years by the old way -				127	1	8

II. In the new way.

	L.	s.	d.	L.	s.	d.
First year's extraordinary expence is, for ploughing and manuring the land, the same as in the old way,	L.22	0	0			
Ploughing once more, at 4s. per acre - -	2	0	0			
Seed, nine gallons per acre, at 4s. per bushel -	2	5	0			
Drilling, at 7d. per acre -	0	5	10			
Hand-hoeing and weeding, at 2s. 6d. per acre -	1	5	0			
Horse-hoeing six times, at 10s. per acre -	5	0	0			
Reaping, binding, and carrying, at 6s. per acre -	3	0	0			
The standing annual charge on ten acres, is -	13	15	10			
Therefore the expence on ten acres in twenty years is - -				275	16	8
Add the extraordinaries of the first year, and the sum is - - -				297	16	8
The yearly produce is at least two quarters of wheat per acre, at 1l. 8s. per quarter; which on ten acres in twenty years, amounts to - -				560	0	0
Therefore, all things paid, there remains clear profit on ten acres in twenty years by the new way - - -				262	3	4

495 Arguments in favour of the drill husbandry.

"So that the profit on ten acres of land in twenty years, in the new way, exceeds that in the old by 135l. 1s. 8d. and consequently is considerably more than double thereof; and ample encouragement to practise a scheme, whereby so great advantage will arise from so small a quantity of land, in the compass of a twenty-one years lease; one year being allowed, both in the old and new way, for preparing the ground.

"It ought withal to be observed, that Mr Tull's husbandry requires no manure at all, though we have here, to prevent objections, allowed the charge thereof for the first year; and moreover, that though the crop of wheat from the drill-plough is here put only at two quarters on an acre, yet Mr Tull himself, by actual experiment and measure, found the produce of his drilled wheat crop amounted to almost four quarters on an acre."

It appears also from a comparative calculation of expence and profit between the drill and common husbandry, taken from Mr Baker's report to the Dublin Society of his experiments in agriculture for the year 1765, that there is a clear profit arising upon an Irish acre of land in 15 years in the drill husbandry of 52l. 3s. 11d. and in the common husbandry of 27l. 19s. 2d.; and therefore a greater profit in the drilled acre in this time of 24l. 4s. 9d. which amounts to 1l. 12s. $3\frac{1}{4}$d. *per annum*. From hence he infers, that in every 15 years the fee-simple of all the tillage-lands of the kingdom is lost to the community by the common course of tillage. In stating the accounts, from which their result is obtained, no notice is taken of fences, water-cutting the land, weeding and reaping, because these articles depend on a variety of circumstances, and will, in general, exceed in the common husbandry those incurred by the other.

Besides, the certainty of a crop is greater in this new way

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way than in the old way of fowing; for moft of the accidents attending wheat crops, are owing to their being late fown, which is neceffary to the farmer in the old way; but in the horfe-hoeing method the farmer may plough two furrows whereon the next crop is to ftand immediately after the firft crop is off. In this manner of hufbandry, the land may be ploughed dry and drilled wet, without any inconvenience; and the feed is never planted under the furrow, but placed juft at the depth which is moft proper, that is, at about two inches; in which cafe it is eafy to preferve it, and there is no danger of burying it. Thus the feed has all the advantage of early fowing, and none of the difadvantages that may attend it in the other way, and the crop is much more certain than by any other means that can be ufed.

The condition in which the land is left after the crop, is no lefs in favour of the horfe-hoeing hufbandry than all the other articles. The number of plants is the great principle of the exhaufting of land. In the common hufbandry, the number is vaftly greater than in the drilling way, and three plants in four often come to nothing, after having exhaufted the ground as much as profitable plants; and the weeds which live to the time of harveft in the common way, exhauft the land no lefs than fo many plants of corn, often much more. The horfe-hoeing method deftroys all the weeds in the far greater part of the land, and leaves that part unexhaufted and perfectly frefh for another crop. The wheat plants being alfo but a third part of the number at the utmoft of thofe in the fowing way, the land is fo much the lefs exhaufted by them; and it is very evident from the whole, that it muft be, as experience proves that it is, left in a much better condition after this than after the common hufbandry.

496 Objections and anfwers.

The farmers who are againft this method object, that it makes the plants too ftrong, and that they are more liable to the blacks or blights of infects for that reafon; but as this allows that the hoeing can, without the ufe of dung, give too much nourifhment, it is very plain that it can give enough; and it is the farmer's fault if he do not proportion his pains fo as to have the advantage of the nourifhment without the difadvantages. It is alfo objected, that as hoeing can make poor land rich enough to bear good crops of wheat, it may make good land too rich for it. But if this fhould happen, the fowing of wheat on it may be let alone a while, and in the place of it the farmer may have a crop of turnips, carrots, cabbages, and the like, which are excellent food for cattle, and cannot be over-nourifhed: or, if this is not chofen, the land, when thus made too rich, may foon be fufficiently impoverifhed by fowing corn upon it in the common old way.

The method of horfe-hoeing hufbandry, fo ftrongly recommended by Mr Tull, is objected to by many on account of the largenefs of the intervals which are to be left between the rows of corn. Thefe are required to be about five feet wide; and it is thought that fuch wide fpaces are fo much loft earth, and that the crop is to be fo much the lefs for it. But it is to be obferved, that the rows of corn feparated by thefe intervals need not be fingle; they may be double, triple, or quadruple, at the pleafure of the farmer; and four rows thus ftanding as one will have the five feet interval but one-fourth of its bignefs as to the whole quantity, and it will be but as fifteen inch intervals to plant in fingle rows. Corn that is fown irregularly in the common way, feems indeed to cover the ground better than that in rows; but this is a mere *deceptio vifus*; for the ftalks of corn are never fo thick as when they come out of one plant, or as when they ftand in a row; and a horfe-hoed plant of corn will have 20 or 30 ftalks in a piece of ground of the fame quantity, where an unhoed plant will have only two or three ftalks. If thefe ftalks of the hoed plant were feparated and planted over the intervals, the whole land would be better covered than it is in the common way; and the truth is, that though thefe hoed fields feem to contain a much lefs crop than the common fown fields, yet they in reality do contain a much greater. It is only the different placing that makes the fown crop feem the larger, and even this is only while both crops are young.

The intervals are not loft ground, as is ufually fuppofed, but when well horfe-hoed they are all employed in the nourifhment of the crop; the roots of the plants in the adjoining rows fpreading themfelves through the whole interval, and drawing fuch nourifhment from it, that they increafe accordingly. When the plants ftand in the fcattered way, as in common fowing, they are too clofe to one another; each robs its neighbour of part of their nourifhment, and confequently the earth is foon exhaufted, and all the plants half ftarved. The clofe ftanding of them alfo prevents the benefit of after-tilling, as the hoe cannot be brought in, nor the ground by any means ftirred between them to give it a new breaking, and confequently afford them new food.

Experiments have abundantly proved, that in large grounds of wheat where the different methods have been tried, thofe parts where the intervals were largeft have produced the greateft crops, and thofe where hoeing was ufed without dung have been much richer than thofe where dung was ufed without hoeing. If it were poffible that plants could ftand as thick, and thrive as well over the whole furface of the ground as they do in the rows feparated by thefe large intervals, the crops of corn fo produced would be vaftly greater than any that have been heard of; but the truth is, that plants receive their growth not according to the ground they ftand on, but to the ground they can extend their roots into; and therefore a fingle row may contain more plants than a large interval can nourifh, and therefore the fame number that ftand in that row, and no more than thefe, could be nourifhed, if fcattered over the whole interval: and they would be much worfe nourifhed in that way; becaufe while the interval is void, the earth may be ftirred about them, and new roots will be formed in great numbers from every one broken by the inftruments, and new nourifhment laid before thefe roots by the breaking the particles of earth, by which the plants will have fupplies that they cannot have when fcattered over the whole furface, becaufe the ground is then all occupied, and cannot be moved between the plants.

497 In what fituations the new method is lefs proper.

All foils and all fituations are not equally proper for this method of planting in rows, with large intervals and hoeing between. The lighteft foils feem to be beft for it, and the tough and wet clays the worft. Such grounds as lie on the fides of hills are alfo lefs proper than others for this work.

This

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This method is not so proper in common fields, but that not in respect of the soil, but of the husbandry of the owners, who are usually in the old way, and change the species of corn, and make it necessary to fallow every second, third, or fourth year. Nevertheless it has been found by later experiments, that the intervals betwixt the rows of plants, as recommended by Mr Tull, were too great, perhaps double of what they should be in the most profitable method of culture; by which means much less crops are obtained than might be produced at nearly the same expence. This has rendered the profits of the drill method much less than they would have been in a more judicious practice, and, consequently, has proved a great disadvantage to it in comparison with the broad-cast. Mr Tull was led into this, partly from the want of more perfect instruments for hoeing, and of ploughs proper for drilling.

To the preceding statements, the following observations by Sir John Anstruther, published among the Select Papers of the Bath Society, may not be improperly subjoined.

498 Observations by Sir John Anstruther.

The slow progress which the drill-husbandry has made in many parts of Great Britain since Mr Tull's time, he observes, has been principally owing to the want of proper drill-ploughs. Before drilling can become general, those ploughs must be simple, such as a common ploughman accustomed to use strong instruments can use without breaking, and such also as common workmen can easily make or repair. Mathematical accuracy he considers as not required for delivering the seed: for it matters very little whether there be a quarter of a peck more or less sown, if it be delivered with tolerable regularity. He therefore had a plough made, according to his own directions, by a common plough-wright, of sufficient strength for any land made fit for turnips or wheat. It was tried on very rough ground unfit for sowing, in order to ascertain its strength; and it had been used for eight years without its needing any repair. It is a double drill-plough, which sows two ridges at a time, the horse going in the furrow between them, and of course does not tread upon the ground intended to be sown; which with a single drill must be the case, and does much harm by the horses feet sinking and making holes in the fine ground, which retain the water, and hurt the wheat when young.

He proceeds to observe, "That having read Mr Forbes upon the extensive practice of the new husbandry, and some other authors, who gave a more clear and distinct account of the different operations in drilling than had heretofore been given, I wished to try them, and to adapt my plough to sow the quantities therein directed. It was, however, adjusted to sow a smaller quantity, and the seed was not steeped.

"Not having ground so proper as I wished, it was drilled on the side of a field, the soil of which was light and sandy, and in such bad order, that the preceding crop was a very indifferent one. It was therefore manured with a compost-dunghill.

"After cross-ploughing and manuring, it was laid into four and a half feet ridges, then harrowed and drilled with one peck and a half of wheat on an acre and a quarter, which is nearly one peck and a fifth per English acre. It was drilled the 27th of October, and rolled after drilling. The crop was late in its appearance, and very backward in the spring.

"March 31st, it was horse-hoed one furrow *from* the rows.

"April 8th, it was hand-hoed and weeded in the rows.

"25th, horse-hoed again, laying a furrow back *to* the rows.

"May 15th, hand-hoed the second time.

"June 2d, horse-hoed *from* the rows.

"June 12th, hand-hoed the third time.

"July 14th, horse-hoed *to* the rows.

"At this last hoeing, as many of the ears were beaten down into the intervals by wind and rain, a man went before the horse-hoe, and turned the ears back into their proper place.

"The crop, when reaped and threshed, yielded me 36 bushels on one acre and a quarter, which is 28 bushels and three pecks per acre; and the produce from one peck and half 96 for one.

"As the produce appeared so great, from land in such bad order, it was carefully measured again, and found to be right. But this increase, though great, was not so large as Mr Crake of Glasgow had without dung.

"Mr Randal says, 'It is an experimental fact, that on a fine loam exquisitely prepared, 144 bushels have been produced from one acre. And, I believe, it is not known what the increase may be brought to in rich lands by high cultivation.'

"Some years since, I had beans dropt alternately with potatoes, at two feet distance in the rows, which were three feet apart, and ploughed in the intervals. The land adjoining was sown with beans and pease, which were a good crop; but those sown among the potatoes a better one. I pulled one stem of the beans planted with the potatoes, which had three branches rising from the bottom, and it produced 225 beans. In all the trials of drilled beans, most of the stems had two branches, with many pods upon each.——From these and other instances, I believe it is not yet known to what increase grain may be brought by drilling, good cultivation, and manure.

"Horse-hoeing is certainly preferable to close drilling or hand-hoeing; but the latter is superior to broad-cast.

"Horse-hoeing the full depth increases to crop, by making it tiller or branch more than it otherwise would do; and the advantage is distinctly observable every hoeing, by the colour of the grain. It prepares the ground for the next crop, at the same time that it increases the crop growing, which hand-hoeing does not, although it may destroy the weeds. Thus drilled ground is kept in a loose open state to receive the benefit of the influence of the air and weather, which broad-cast has not; and it is evident, from certain experience, that crops may be drilled many years to good advantage without manure.

"Suppose the crops only 20 bushels per acre, what course of broad-cast crops will give 5l. an acre for the course? But suppose they are dunged the same as any ground in the most approved course, there is the greatest reason to expect as much as in the above experiment,

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ment, which is 28¾, and at 5s. per bushel amounts to 7l. 3s. 9d.

"Calculations may be of service to those who wish to try drilling, and have few books to direct them.

"One acre is 10 chains long, of 660 feet, or 220 yards long, and one yard broad, containing 4840 square yards. Then if the ridge is four feet six inches, this makes 24 ridges and three feet to spare. This length of 220 yards multiplied by 14 (the number of ridges), gives a length of yards 3080, to which add 146 for the spare three feet, and it will be 3226 yards. And as two rows are drilled on a ridge, the number of rows will be in length 6452 yards; but as a deduction of 172 yards must be made for the head ridges, suppose three yards each, &c. the whole length to be sown will be 6280 yards clear. Now a gallon (Winchester) holds about 80,000 grains. The quantity recommended to be drilled by Mr Forbes and others, being six gallons, or two-thirds of a bushel per acre, is nearly 78 grains to a yard, or 26 to a foot. But in my experiment, by this calculation, it was only about 11 grains to a foot: which is quite sufficient, if the seed be good, and it be not destroyed by vermin.

"Now with regard to the quantity of land this drill-plough may sow; if a horse walks at the rate of two miles per hour, he goes 16 miles in eight hours, or 28,460 yards. As he sows two ridges at once, this is seven lengths, and two-thirds per acre, or 1686 yards to sow an acre, being nearly 17 acres in a day.

"Four horse-hoeings are calculated equal to two ploughings. In plain ploughing they suppose the ridge is ploughed with four furrows, or eight for twice ploughing. The four horse-hoeings are eight furrows, equal to two ploughings.

"Mr Tull directs four hoeings, and Mr Forbes five. 1st, In November, when the plant has four blades. 2dly, In March, deep, and nearer the rows than the former; both these hoeings should be *from* the rows. 3dly, Hand-hoed when it begins to spindle, if the earth be crumbly, *to* the rows. 4thly, When it begins to blossom, *from* the rows, but as near to them as in the second hoeing. 5thly, When done blossoming, to ripen and fill the grain, *to* the rows.

"The last hoeing Mr Tull does not direct, but Mr Forbes advises it, as being of essential service in filling the grain, and saving trouble in making the next seed-furrows. They advise the patent or sowing-plough for horse-hoeing; and the expence is calculated by Mr Craick at one guinea per acre, reaping included.

"But let us suppose the following, which are the prices in the county I live in (Fife).

	L.	s.	d.
Ploughing to form the ridges, -	0	4	0
Harrowing, - -	0	0	4
Four hoeings, equal to two ploughings,	0	8	0
Sowing, - - -	0	0	4
Hand-hoeing twice, - -	0	8	0
Seed, one peck and a half, at 5s. a bushel,	0	1	10
Whole expence per acre,	L. 1	2	6"

499 The drill and the broad-cast methods more particularly compared.

Drill-husbandry is, as a good writer has justly defined it, "*the practice of a garden brought into the field.*" Every man of the least reflection must be sensible, that the practice of the garden is much *better* than that of the field, only a little more expensive; but if (as is the case) this extra expence be generally much more than repaid by the superior goodness and value of drilled crops, it ought to have no weight in comparing the two modes of husbandry.

In the broad-cast method the land is often sown in bad tilth, and always scattered at random, sometimes by very unskilful hands. In drilling, the land must be in fine order; the seed is set in trenches drawn regularly, all of nearly an equal depth, and that depth suited to the nature of each kind of seed. These seeds are also distributed at proper distances, and by being equally and speedily covered, are protected from vermine and other injuries; so that the practice of the garden is here exactly introduced into the field.

In the broad-cast method the seed falls in some places too thick, in others too thin; and being imperfectly covered, a part of it is devoured by vermin which follow the sower; another part is left exposed to rain or frost, or to heats, which greatly injure it. When harrowed, a great part of it (small seeds especially) is buried so deep, that if the soil be wet, it perishes before it can vegetate.

Again: When thus sown, there is no meddling with the crop afterwards, because its growth is irregular. The soil cannot be broken to give it more nourishment, nor can even the weeds be destroyed without much inconvenience and injury.

But in the drill-husbandry the intervals between the rows, whether double or single, may be horse-hoed; and thereby nourishment may repeatedly be given to the plants, and the weeds almost totally destroyed.

The very same effects which digging has upon young shrubs and trees in a garden, will result from horse-hoeing in a field, whether the crop be corn or pulse: For the reason of the thing is the same in both cases, and being founded in nature and fact, cannot ever fail. In drilling, no more plants are raised on the soil than it can well support; and by dividing and breaking the ground they have the full advantage of all its fertility.

The plough prepares the land for a crop, but goes no further; for in the broad-cast husbandry it cannot be used: but the crop receives greater benefit from the tillage of the land by the horse-hoe, while it is growing, than it could in the preparation. No care in tilling the land previous to sowing can prevent weeds rising with the crop; and if these weeds be not destroyed while the crop is growing, they will greatly injure it. In the broad-cast husbandry this cannot be done; but in drilling, the horse-hoe will effect it easily.

And what adds to the farmer's misfortune is, that the most pernicious weeds have seeds winged with down, which are carried by the wind to great distances; such as thistles, sow-thistles, colts-foot, and some others.

If the expence of horse-hoeing be objected, there are two answers which may very properly be made: The first is, that this expence is much less than that of hand-hoeing were it practicable, or of hand-weeding. The second is, that it is more than repaid by the quantity of seed saved by drilling; to say nothing of the extra quantity and goodness of the crops, which are generally self-evident.

Upon the whole: If the particular modes of cultivating land by the new husbandry should, after all, be considered

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considered as perhaps too limited to be universally adopted; yet it has been of great use in raising suspicions concerning the old method, and in turning the views of philosophers and farmers towards improving in general. Many real improvements in agriculture have been the consequences of these suspicions; and as this spirit of inquiry remains in full vigour, a solid foundation is laid for expecting still further improvements in this useful art.

500 The drill-husbandry is not a modern discovery.

It may be proper here to remark, however, that the drill-husbandry is by no means a modern European invention. It is now used in the Carnatic, and in all probability has existed among the industrious nations of India from a very early period. It is used not only for all grains, but also for the culture of tobacco, cotton, and the castor-oil plant. Besides the drill-plough, and the common plough, the Indians use a third, with a horizontal share, which immediately follows the drill-plough at work. It is set into the earth, about the depth of 7 or 8 inches, and passes under three drills at once. It operates by agitating the earth, so as to make the sides of the drills fall in and cover the seed, which it does so effectually as scarcely to leave any traces of a drill.

PART II. CULTIVATION OF VEGETABLES MORE PROPERLY ARTICLES OF COMMERCE.

THESE in general are such as cannot be used for food; and are principally flax, hemp, rape, hops, and timber of various kinds. Of each of these we shall treat particularly in the following sections.

Sect. I. *Of Flax and Hemp.*

501 Flax and hemp.

Flax is cultivated not only with a view to the common purposes of making linen, but for the sake of its seed also; and thus forms a most extensive article of commerce, all the oil used by painters, at least for common purposes, being extracted from this seed. The cake which remains after the extraction of the oil is in some places used as a manure, and in others sold for fattening of cattle. In the Vale of Gloucester, Mr Marshall informs us, that it is, next to hay, the main article of stall-fattening; though the price is now become so great, that it probably leaves little or no profit to the consumer, having within a few years risen from three guineas to six and six and a half, and the lowest price being five guineas per ton; and even this is lower than it was lately. Hence some individuals have been induced to try the effect of linseed itself boiled to a jelly, and mixed with flour, bran, or chaff, with good success, as Mr Marshall has been informed; and even the oil itself has been tried for the same purpose in Herefordshire. Though this plant is in universal culture over the whole kingdom, yet it appears by the vast quantity imported, that by far too little ground is employed in that way. As Mr Marshall takes notice of its culture only in the county of Yorkshire, it probably does not make any great part of the husbandry of the other counties of which he treats; and even in Yorkshire he tells us, that its cultivation is confined to a few districts. The kind cultivated there is that called *blea line*, or *the blue or lead-coloured flax*, and this requires a rich dry soil for its cultivation. A deep, fat, sandy loam is perhaps the only soil on which it can be cultivated with advantage. If sown upon old corn land, it ought to be well cleaned from weeds, and rendered perfectly friable by a summer-fallow. Manure is seldom or ever set on for a line crop: and the soil process consists generally of a single ploughing. The seed-time is in the month of May, but much depends on the state of the soil at the time of sowing. "It should neither be wet nor dry; and the surface ought to be made as fine as that of a garden bed. Not a clod of the size of an egg should remain unbroken." Two bushels of seed are usually sown upon an acre: the surface, after being harrowed, is sometimes raked with garden or hay rakes; and the operation would be still more complete if the clods and other obstructions, which cannot be easily removed, were drawn into the interfurrows. A light hand-roller used between the final raking and harrowing would much assist this operation. The chief requisite during the time of vegetation is weeding, which ought to be performed with the utmost care; and for this reason it is particularly requisite that the ground should be previously cleansed as well as possible, otherwise the expence of weeding becomes too great to be borne, or the crop must be considerably injured. It is an irreparable injury, if, through a dry season, the plants come up in two crops; or if by accident or mismanagement they be too thin. The goodness of the crop depends on its running up with a single stalk without branches: for wherever it ramifies, there the length of the line terminates; and this ramification is the consequence of its having too much room at the root, or getting above the plants which surround it. The branches are never of any use, being unavoidably worked off in dressing; and the stem itself, unless it bear a due proportion to the length of the crop, is likewise worked off among the refuse. This ramification of the flax will readily be occasioned by clods on the ground when sown. A second crop is very seldom attended with any profit; for being overgrown with the spreading plants of the first crop, it remains weak and short, and at pulling time is left to rot upon the land.

502 Linseed-cake, linseed itself, and linseed oil, used for fattening cattle.

503 Culture of flax in Yorkshire.

Flax is injured not only by drought but by frost, and is sometimes attacked even when got five or six inches high, by a small white slug, which strips off the leaves to the top, and the stalks bending with their weight are thus sometimes drawn into the ground. Hence, if the crop does not promise fair at weeding time, our author advises not to bestow farther labour and expence upon it. A crop of turnips or rape will generally pay much better than such a crop of flax. The time of flax-harvest in Yorkshire is generally in the latter end of July or beginning of August.

504 Mr Marshall's remarks on flax crops.

On the whole, our author remarks, that "the goodness of the crop depends in some measure upon its length; and this upon its evenness and closeness upon the ground. Three feet high is a good length, and the

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the thicknefs of a crow's quill a good thicknefs. A fine ftalk affords more line and fewer fhivers than a thick one. A tall thick fet crop is therefore defirable. But unlefs the land be good, a thick crop cannot attain a fufficient length of ftem. Hence the folly of fowing flax on land which is unfit for it. Neverthelefs, with a fuitable foil, a fufficiency of feed evenly diftributed, and a favourable feafon, flax may turn out a very profitable crop. The flax crop, however, has its difadvantages: it interferes with harveft, and is generally believed to be a great exhaufter of the foil, efpecially when its feed is fuffered to ripen. Its cultivation ought therefore to be confined to rich grafsland diftricts, where harveft is a fecondary object, and where its exhauftion may be rather favourable than hurtful to fucceeding arable crops, by checking the too great ranknefs of rich frefh broken ground.

505 Mr Bartley's experiments.

In the 5th volume of Bath Papers, Mr Bartley, near Briftol, gives an account of the expences and produce of five acres of flax cultivated on a rich loamy fand. The total expence was 42l. 13s. 4d. the produce was ten packs of flax at 5l. 5s. value 52l. 10s. 35 bufhels of linfeed at 5s. value 8l. 15s. the net profit therefore was 18l. 11s. 8d. or 4l. 13s. 4d. per acre. This gentleman is of opinion that flax-growers ought to make it their ftaple article, and confider the other parts of their farm as in fubferviency to it.

506 Remarks by a Dorfetfhire gentleman.

In the fecond volume of Bath Papers, a Dorfetfhire gentleman, who writes on the culture of hemp and flax, gives an account fomewhat different from that of Mr Marfhall. Inftead of *exhaufting* crops, he maintains that they are both *ameliorating* crops, if cut without feeding; and as the beft crops of both are raifed from foreign feed, he is of opinion that there is little occafion for raifing it in this country. A crop of hemp, he informs us, prepares the land for flax, and is therefore clear gain to the farmer. "That thefe plants impoverifh the foil," he repeats, "is a mere vulgar notion, devoid of all truth.—The beft hiftorical relations, and the verbal accounts of honeft ingenious planters, concur in declaring it to be a vain prejudice, unfupported by any authority; and that thefe crops really meliorate and improve the foil." He is likewife of opinion, that the growth of hemp and flax is not neceffarily confined to rich foils, but that they may be cultivated with profit alfo upon poor fandy ground, if a little expence be laid out in manuring it. "Spalding-moor in Lincolnfhire is a barren fand; and yet with proper care and culture it produces the beft hemp in England, and in large quantities. In the ifle of Afholme, in the fame county, equal quantities are produced; for the culture and management of it is the principal employ of the inhabitants; and, according to Leland, it was fo in the reign of Henry VIII. In Marfhland the foil is a clay or ftrong warp, thrown up by the river Oufe, and of fuch a quality, that it cracks with the heat of the fun, till a hand may be put into the chinks; yet if it be once covered with the hemp or flax before the heats come on, the ground will not crack that fummer. When the land is fandy, they firft fow it with barley, and the following fpring they manure the ftubble with horfe or cow dung, and plough it under. Then they fow their hemp or flax, and harrow it in with a light harrow, having fhort teeth. A good crop deftroys all the weeds, and makes it a fine fallow for flax in the fpring. As foon as the flax is pulled, they prepare the ground for wheat. Lime, marl, and the mud of ponds, is an excellent compoft for hemp-lands."

507 Flax and hemp may be cultivated upon poor as well as rich foils.

508 Vaft quantities of flax and hemp imported into Britain.

Our author takes notice of the vaft quantity of flax and hemp, not lefs than 11,000 tons, imported in the year 1763 into Britain; and complains that it is not raifed in the ifland, which he thinks might be done, though it would require 60,000 acres for the purpofe. He obferves, that the greater part of thofe rich marfhy lands lying to the weft of Mendip hills are very proper for the cultivation of hemp and flax; and if laid out in this manner could not fail of turning out highly advantageous both to the landholders and the public at large. "The vaft quantities of hemp and flax (fays he) which have been raifed on lands of the fame kind in Lincolnfhire marfhes, and the fens of the Ifle of Ely and Huntingdonfhire, are a full proof of the truth of my affertion. Many hundreds of acres in the above-mentioned places, which, for pafturage or grazing, were not worth more than twenty or twenty-five fhillings per acre, have been readily let at 4l. the firft year, 3l. the fecond, and 2l. the third. The reafon of this fuppofed declining value of land, in proportion to the number of years fown with flax, is, that it is ufual with them to feed it for the purpofe of making oil, that being the principal caufe of the land being thereby impoverifhed.

It is certain, however, that the quantity of hemp exported from St Peterfburgh in Britifh fhips has continued to increafe, fo that in 1785 the quantity of hemp exported from Peterfburgh in Britifh fhips was as follows:

	Poods.
Of clean hemp,	1,038,791
Outfhot,	37,382
Half clean,	18,374
Hemp codille,	19,251
	1,113,798

There are 63 poods to a ton, confequently the whole amounted to 17,695 tons; and it is faid that this quantity has fince been tripled and quadrupled. It is therefore an object of great national importance to confider, whether flax and hemp might not be profitably reared in our own country without producing any alarm concerning their tendency to exhauft the foil. With this view we fhall here ftate the fubftance of a report made by Mr Durno, Britifh conful at Pruffia in 1789, to the lords of the Committee of Council for Trade, concerning the method of cultivating flax and hemp in Pruffia, Ruffia, and Poland.

509 Mr Durno's report on the culture of flax and hemp in Pruffia, &c.

A black, not moraffy open gravelly foil is preferred, as flax and hemp become exuberant and coarfe on too rich a foil. To afcertain the proper middle degree of ftrength of foil, previous crops of grain are taken. On a vigorous foil wheat is firft fown; then rye, barley, oats; and laft of all flax or hemp. Two fucceffive crops of hemp are taken if the land is intermediately dunged. For one crop of flax, it is not dunged at all. On a foil of lefs ftrength, flax and hemp are fown immediately after a winter crop of rye, the land being ploughed in autumn, if the weather allows, if not, in fpring. It is then harrowed and manured, and again ploughed

Flax and Hemp.

ploughed immediately before ſowing. Another winter crop of rye may immediately be ſown in the ſame field after drawing the flax or hemp, but after the flax; dung is in this caſe neceſſary. A field that has been laid down in fallow, if only ploughed up, yields a better crop of flax than if manured and cultivated in the above or any other way. Flax and hemp are ſown from the 25th of May to the 10th of June, and the flax is reaped in the end of Auguſt, and hemp in the end of September.

As to their effects on the ſoil, no kind of grain can be ſown immediately after a crop of flax without dunging, but after one of hemp, any grain, and even hemp itſelf, may be ſown without manure. Hemp cleans the ground by ſuffocating, by its broad leaves, all ſorts of weeds or undergrowth; but flax muſt be weeded once or twice before it blooms. Flax is plucked when the ſtalk becomes yellowiſh, the pods brown, and the ſeed hard and full bodied. For finer flax, the ſtalk is pulled while yet green; but the ſeed is then ſacrificed, and fit only for cruſhing for oil, of which it produces a ſmall quantity. Hemp is alſo plucked or drawn when the ſtalk and pods have changed colour. If the flax is very dry when plucked, the ſeed is ſtripped off immediately; if not, it is allowed to dry on the field. Seed-pods are ſpread thinly on a floor, where they are turned twice a-day, till ſo dry that they open of themſelves; when it is threſhed and cleaned like other grain. To gain the hemp-ſeed, the hemp itſelf, when plucked, is ſet on end againſt any convenient place. The roots and top-ends are then cut off. The roots are thrown away, and the top-ends are threſhed out and cleaned. The ſeed is apt to be ſpoiled by remaining in a moiſt ſtate for any length of time.

As ſoon as the ſeed has been gained, the flax and and hemp are ſteeped in water till the flax ſeparate from the rind, and the hemp till the harl ſprings from the ſtalk. In ſoft water, in warm weather, nine or ten days are ſufficient for this purpoſe. In hard water, with cold weather, from fourteen days to three weeks are requiſite. Stagnate is preferred to running water; but fiſh ponds and the drinking places of cattle muſt be avoided, as the fiſh would be deſtroyed, and the water would be rendered unwholeſome and unpalatable to the cattle; but a muddy or ſlimy bottom is preferred. In the ſouthern provinces of Poland, as Volkinia, Podolia, &c. ſteeping is not practiſed, on the ſuppoſition that it weakens the harl and darkens the colour, though this idea ſeems to have no foundation.

After being taken out of the ſteep, the flax is dried on a graſs field; after which it is gathered up into ſmall ſtacks; but the hemp, inſtead of being ſpread out on a field, is ſet up againſt the walls of buildings till it is alſo dried, after which they are both houſed.

It is generally underſtood in theſe countries, that the cultivation of flax and hemp is more profitable than that of any kind of grain.

510 Culture of flax in Ireland.

To this we ſhall add a conciſe ſtatement of the mode of cultivating flax in Ireland. A good crop of flax is there expected from any ſtrong clays that are fit for the growth of corn; but an open black loamy ſoil, enriched by having lain long in paſture, is preferable. The ground muſt be in fine tilth, and as free from weeds as poſſible. Potatoes uſually precede flax, though turnips, beans, or any manured crop, are a good preparation; but the firſt or ſecond crop after paſture is preferred to any of theſe. Stubble lands, that have been long in tillage, may, by proper preparation, bring a crop; but it is apt to fail in ſuch ſituations, the ſtalks turning to a reddiſh colour called *firing* before it ripens; upon which it muſt immediately be pulled. Two buſhels of ſeed are uſed to the Engliſh acre, unleſs for the purpoſe of a very fine manufacture; in which caſe a large quantity of ſeed is uſed, and the flax is pulled very green. The ſeaſon of ſowing is the firſt fine weather after the middle of March. The moſt approved mode of culture is in beds about ſix feet broad, covering the ſeed about an inch and a half deep, with earth ſhoveled out of the furrows: but the moſt ordinary mode is to ſow on common ridges, and to harrow in the ſeed. Before the flax is five inches high it ſhould be carefully hand-weeded; and, if any part lodges, it ſhould be turned over. The produce is uſually worth 7l. ſterling the Engliſh acre. The crop ſhould ſtand till the lower part of the ſtalk becomes yellowiſh, and the under leaves begin to wither, unleſs the ſeed is to be preſerved, which is done by rippling it through an iron comb, and the flax may be ſteeped immediately after it is pulled. Turf-bog water, if clear, anſwers well, but foul ſtagnate water ſtains the flax. Too pure a ſpring is injurious. A reſervoir dug in clay is preferred. The time of lying in the ſteep depends upon the quality of the water and the ſtate of the weather. It is dried on graſs by being ſpread thin; artificial heat has been recommended for drying flax; but no good form of it has been ſuggeſted.

511 Sheep employed to weed flax.

In addition to what is here ſtated, the compiler of this article accounts it proper to take notice of a mode of weeding flax that has frequently been practiſed in Scotland. It conſiſts of turning a flock of ſheep at large into the field. They will not taſte the young flax plants, but they carefully ſearch for the weeds which they devour. It may alſo be remarked, that for drying flax in wet ſeaſons, the ſteam kiln formerly propoſed would be a valuable inſtrument. N° 34.

Sect. II. *Rape or Cole-Seed.*

Rape or Cole-Seed.

This, as well as linſeed, is cultivated for the purpoſe of making oil, and will grow almoſt anywhere. Mr Hazard informs us, that in the north of England the farmers pare and burn their paſture lands, and then ſow them with rape after one ploughing; the crop commonly ſtanding for ſeed, which will bring from 25l. to 30l. per laſt (80 buſhels). Poor clay, or ſtone-braſh land, will frequently produce from 12 to 16 or 18 buſhels per acre, and almoſt any freſh or virgin earth will yield one plentiful crop; ſo that many in the northern counties have been raiſed, by cultivating this ſeed, from poverty to the greateſt affluence. The ſeed is ripe in July or the beginning of Auguſt; and the thraſhing of it out is conducted with the greateſt mirth and jollity.

Bath Papers, vol. iv.

512 Advantage of cultivating rape-ſeed.

513 Of cutting and thraſhing the rape-ſeed.

The rape being fully ripe, is firſt cut with ſickles, and then laid thin upon the ground to dry; and when in proper condition for thraſhing, the neighbours are invited, who readily contribute their aſſiſtance. The thraſhing is performed on a large cloth in the middle of

Rape or Cole-seed. of the field, and the seed put into the sacks and carried home. It does not admit of being carried from the field in the pod in order to be thrashed at home, and therefore the operation is always performed in the field; and by the number of assistants procured on this occasion, a field of 20 acres is frequently thrashed out in one day. The straw is burnt for the sake of its alkali, the ashes being said to equal the best kind of those imported from abroad.

514 Of sowing it. The proper time for sowing rape is the month of June; and the land should, previous to the sowing, be twice well ploughed. About two pounds of seed are sufficient for an acre; and, according to our author, it should be cast upon the ground with only the thumb and two fore fingers; for if it be cast with all the fingers, it will come up in patches. If the plants come up too thick, a pair of light harrows should be drawn along the field length-wise and cross-wise; by which means the plants will be equally thinned; and when the plants which the harrows have pulled up are withered, the ground should be rolled. A few days after the plants may be set out with a hoe, allowing 16 or 18 inches distance betwixt every two pants.

515 Transplanting recommended. Mr Hazard strongly recommends the transplanting of rape, having experienced the good effects of it himself. A rood of ground, sown in June, will produce as many plants as are sufficient for 10 acres; which may be planted out upon ground that has previously borne a crop of wheat, provided the wheat be harvested by the middle of August. One ploughing will be sufficient for these plants; the best of which should be selected from the seed-plot, and planted in rows two

516 Sheep may be fed in the spring with rape. feet asunder and 16 inches apart in the rows. As rape is an excellent food for sheep, they may be allowed to feed upon it in the spring; or the leaves might be gathered, and given to oxen or young cattle: fresh leaves would sprout again from the same stalks, which in like manner might be fed off by ewes and lambs in time enough to plough the land for a crop of barley and oats. Planting rape in the beginning of July, however, would be most advantageous for the crop itself, as the leaves might then be fed off in the autumn, and new ones would appear in the spring. Our author discommends the practice of sowing rape with turnips, as the crops injure one another. "Those who look for an immediate profit (says he), will undoubtedly cultivate rape for seed; but perhaps it may answer better in the end to feed it with sheep: the fat ones might cull it over first, and afterwards the lean or store-sheep might follow them, and be folded thereon; if this is done in the autumn season, the land will be in good heart to carry a crop of wheat; or where the rape is fed off in the spring, a crop of barley might follow. In either case rape is profitable to the cultivator; and when it is planted, and well earthed round the stems, it will endure the severest winter; but the same cannot be advanced in favour of that which is sown broad-cast.

517 Culture of rape-seed in Brabant. Cole-seed is cultivated in Brabant, in the following manner, according to the Abbé Mann. "It is sown about the middle of July, and the young plants are transplanted about the end of September. This is done with a narrow spade sunk into the ground, and moved with the hand forwards and backwards; which simple motion, makes a sufficient opening to receive the plant; a boy or girl follow the labourer with plants, and putting one of them into each hole, treads against it to close it up. If the plantation is done with the plough, the plants are placed at regular distances in the furrow, and are covered with the earth turned up with the succeeding furrow. Sometimes, after the cole-seed is planted, the foot of the stalks is covered, by means of a common spade or hoe, with the earth near it, which furnishes nourishment for the plants during winter, by the crumbling of these little clods of earth over the roots. The cole-seed is reaped about midsummer or later, according as the season is more or less advanced; it is left on the field for ten or twelve days after it is cut, and then thrashed on a kind of sail-cloth, spread on the ground for that purpose, and the seed carried in sacks to the farm. When the crop is good, a bunder produces about forty raziers of 80lbs. weight each. It is to be observed, that the ground whereon cole-seed is to be planted, must be dunged and twice ploughed the same year it is put in use."

Coriander-Seed, Canary-Seed, &c.

Sect. III. *Coriander-Seed.*

This is used in large quantities by distillers, druggists, and confectioners, and might be a considerable object to such farmers as live in the neighbourhood of great towns; but the price is very variable, *viz.* from 16s. to 42s. per cwt. In the 4th volume of Bath Papers, Mr Bartley gives an account of an experiment made on this seed, which proved very successful. Ten perches of good sandy loam were sown with coriander on the 23d of March 1783. Three pounds of seed were sufficient for this spot; and the whole expence amounted only to 5s. 10d. The produce was 87 pounds of seed, which, valued at 3d. yielded a profit of 5s. 11d. or 15l. 18s. 4d. per acre. He afterwards made several other experiments on a larger scale; but none of the crops turned out so well, though all of them afforded a good profit. 518 Mr Bartley's experiment.

Sect. IV. *Canary-Seed.*

This is cultivated in large quantity in the Isle of Thanet, where it is said they have frequently 20 bushels to an acre. Mr Bartley, in the month of March 1783, sowed half an acre of ground, the soil a mixture of loam and clay, but had only eight bushels and a half, or 17 bushels per acre. With this produce, however, he had a profit of 4l. 2s. 3d. per acre. 519 Culture of canary-seed.

Sect. V. *Woad.*

The use of this in dyeing is well known, and the consumption is so great, that the raising of the plant might undoubtedly be a object to an husbandman, provided he could get it properly manufactured for the dyers, and could overcome their prejudices. At present, the growing of this plant is in a manner monopolized by some people in particular places, particularly at Keynsham near Bristol in England. Mr Bartley informs us, that in a conversation he had with these growers, the latter asserted, that the growth of woad was peculiar to their soil and situation. The soil about this place is a blackish heavy mould, with a considerable proportion of clay, but works freely: that of Brislington, 520 Woad easily cultivated.

Hops. Brislington, where Mr Bartley resides, a hazel sandy loam; nevertheless, having sowed half an acre of this soil with woad-seed, it throve so well, that he never saw a better crop at Keynsham. Having no apparatus, however, or knowledge of the manufacture, he suffered it to run to seed, learning only from the experiment, that woad is very easily cultivated, and that the only difficulty is the preparing it for the market.

Sect. VI. *Hops.*

521 Hops forbid by act of parliament.

The uses of these as an ingredient in malt liquors, are well known. Formerly, however, they were supposed to possess such deleterious qualities, that the use of them was forbid by act of parliament in the reign of James VI. But though this act was never repealed, it does not appear that much regard was ever paid to it, as the use of hops has still continued, and is found not to be attended with any bad effects on the human constitution. The only question, therefore, is, How far the raising a crop of them may be profitable to an husbandman? and indeed this seems to be very doubtful.

Mr Arthur Young, in a Fortnight's Tour through Kent and Essex, informs us‡, that at Castle Hedingham he was told by a Mr Rogers, who had a considerable hop-plantation, that four acres of hop-ground cost him upwards of 120l. and that the usual expences of laying out an acre of ground in this way amounted to 34l. 6s. By a calculation of the expences of an acre in Kent, it appeared that the money sunk to plant an acre there amounted to 32l. 8s. 6d.; that the annual expence was 23l. and the profit no more than 1l. 8s. 1d. In another place, he was informed by a Mr Potter, who cultivated great quantities of hops, that if it were not for some extraordinary crops which occured now and then, nobody would plant them. In Essex, the expences of a hop-plantation are still greater than those we have yet mentioned; an acre many years ago requiring 75l. to lay it out on hops, and now not less than 100l. the annual expence being estimated at 31l. 1s. while the produce commonly does not exceed 32l.

‡ *Annals of Agriculture*, vol. ii.

522 Expence of cultivating them at Castle Hedingham.

523 In Essex.

In the neighbourhood of Stow-market in this county, Mr Young informs us, there are about 200 acres planted with hops, but "18 or 20 are grubbed up within two years, owing to the badness of the times." Here they are planted on a black loose moor, very wet and boggy; and the more wet the better for the crop, especially if the gravel, which constitutes the bottom, be not more than three feet from the surface. In preparing the ground for hops, it is formed into beds, 16 feet wide, separated from each other by trenches. In these beds they make holes six feet asunder, and about 12 inches diameter, three rows upon a bed. Into each hole they put about half a peck of very rotten dung or rich compost; scatter earth upon it, and plant seven sets in each; drawing earth enough to them afterwards to form something of a hillock. A hop garden, Mr Young informs us, "will last almost for ever, by renewing the hills that fail, to the amount of about a score annually, but it is reckoned better to grub up and new-plant it every 20 or 25 years."

In this volume of the Annals, Mr Young informs us, that "one profit of hop-land is that of breaking it up. Mr Potter grubbed up one garden, which failing, he ploughed and sowed barley, the crop great: then mazagan beans, two acres of which produced 16 quarters and five bushels. He then sowed it with wheat, which produced 13 quarters and four bushels and an half: but since that time the crops have not been greater than common. The same gentleman has had 10 quarters of oats after wheat." In the ninth volume of the same work, however, we have an account of an experiment by Mr Le Bland of Sittingbourn in Kent, of grubbing up 12 acres of hop-ground, which was not attended with any remarkable success. Part of the hops were grubbed up in the year 1781, and mazagan beans sown in their stead: but by reason of the seed being bad, and the dry summer, the crop turned out very indifferent. Next year the remainder of the hops were grubbed up, and the whole 12 acres sown with wheat; but still the crop turned out very bad, owing to the *wet* summer of that year. It was next planted with potatoes, which turned out well: and ever since that time the crops have been good. This gentleman informs us, that the person who had the hop-ground above-mentioned did not lose less by it than 1500l.

Cultivation of Fruit.

524 Profit of breaking up hop-land precarious.

525 Culture of hops in Norfolk on the decline.

The culture of hops seems to be confined in a great measure to the southern counties of England; for Mr Marshall mentions it as a matter of surprise, that in Norfolk he saw a "tolerably large hop garden." The proprietor informed him, that three or four years before there had been 10 acres of hops in the parish (Blowfield) where he resided; which was more than could be collected in all the rest of the county; but at that time there were not above five: and the culture was daily declining, as the crops, owing to the low price of the commodity, did not defray the expence.

From all this it appears, that hops are perhaps the most uncertain and precarious crop on which the husbandman can bestow his labour. Mr Young is of opinion, that some improvement in the culture is necessary; but he does not mention any, excepting that of planting them in espaliers. This method was recommended both by Mr Rogers and Mr Potter above-mentioned. The former took the hint from observing, that a plant which had been blown down, and afterwards shot out horizontally, always produced a greater quantity than those which grew upright. He also remarks, that hops which are late picked carry more next year than such as are picked early; for which reason he recommends the late picking. The only reason for picking early is, that the hops appear much more beautiful than the others.

Sect. VII. *Cultivation of Fruit.*

In Herefordshire and Gloucestershire the cultivation of fruit for the purpose of making a liquor from the juice, forms a principal part of their husbandry. In Devonshire also considerable quantities of this kind of liquor are made, though much less than in the two counties above-mentioned. 526

526 Fruits cultivated in Herefordshire and Gloucestershire.

The fruits cultivated in Herefordshire and Gloucestershire are, the apple, the pear, and the cherry. From the two first are made the liquors named *cyder and perry*;

ry; but though it is probable that a liquor of ſome value might be made from cherries alſo, it does not appear to have ever been attempted. Mr Marſhall remarks, that nature has furniſhed only one ſpecies of pears and apples, *viz.* the common crab of the woods and hedges, and the wild pear, which is likewiſe pretty common.

527 Varieties of fruits entirely artificial.

The varieties of theſe fruits are entirely artificial, being produced not by ſeed, but by a certain mode of culture; whence it is the buſineſs of thoſe who wiſh to improve fruit therefore, to catch at ſuperior accidental varieties; and having raiſed them by cultivation to the higheſt perfection of which they are capable, to keep them in that ſtate by artificial propagation.

528 Varieties cannot be made permanent.

Mr Marſhall, however, obſerves, that it is impoſſible to make varieties of fruit altogether permanent, though their duration depends much upon management. "A time arrives (ſays he) when they can no longer be propagated with ſucceſs. All the old fruits which raiſed the fame of the liquors of this country are now loſt, or ſo far on the decline as to be deemed irrecoverable. The *red-ſtreak* is given up; the celebrated *ſtir-apple* is going off; and the *ſquaſh-pear*, which has probably furniſhed this country with more *champaign* than was ever imported into it, can no longer be got to flouriſh: the ſtocks canker, and are unproductive. In Yorkſhire ſimilar circumſtances have taken place: ſeveral old fruits which were productive within my own recollection are loſt; the ſtocks cankered and the trees would no longer come to bear."

Our author controverts the common notion among orchard-men, that the decline of the old fruits is owing to a want of freſh grafts from abroad, particularly from Normandy, from whence it is ſuppoſed that apples were originally imported into this country. Mr Marſhall, however, thinks, that theſe original kinds have been long ſince loſt, and that the numerous varieties of which we are now poſſeſſed were raiſed from ſeed in this country. He alſo informs us, that at Ledbury he was ſhown a Normandy apple tree, which, with many others of the ſame kind, had been imported immediately from France. He found it, however, to be no other than the *bitter-ſweet*, which he had ſeen growing as a neglected wilding in an Engliſh hedge.

529 Mr Marſhall's directions for raiſing new varieties of fruit.

The proceſs of raiſing new varieties of apples, according to Mr Marſhall, is ſimple and eaſy. "Elect (ſays he) among the native ſpecies individuals of the higheſt flavour; ſow the ſeeds in a highly enriched ſeed-bed. When new varieties, or the improvement of old ones, are the objects, it may perhaps be eligible to uſe a frame or ſtove; but where the preſervation of the ordinary varieties only is wanted, an ordinary loamy ſoil will be ſufficient. At any rate, it ought to be perfectly clean at leaſt from root weeds, and ſhould be double dug from a foot to 18 inches deep. The ſurface being levelled and raked fine, the ſeeds ought to be ſcattered on about an inch aſunder and covered about half an inch deep with ſome of the fineſt mould previouſly raked off the bed for that purpoſe. During ſummer the young plants ſhould be kept perfectly free from weeds, and may be taken up for tranſplantation the enſuing winter; or if not very thick in the ſeed-bed, they may remain in it till the ſecond winter.

520 Of the nurſery ground.

The nurſery ground ought alſo to be enriched, and double dug to the depth of 14 inches at leaſt; though 18 or 20 are preferable. The ſeedling plants ought to be ſorted agreeably to the ſtrength of their roots, that they may riſe evenly together. The top or downward roots ſhould be taken off, and the longer ſide rootlets ſhortened. The young trees ſhould then be planted in rows three feet aſunder, and from 15 to 18 inches diſtant in the rows; taking care not to cramp the roots, but to lead them evenly and horizontally among the mould. If they be intended merely for ſtocks to be grafted, they may remain in this ſituation until they be large enough to be planted out; though, in ſtrict management, they ought to be re-tranſplanted two years before their being transferred into the orchard, "in freſh but unmanured double-dug ground, a quincunx four feet apart every way." In this ſecond tranſplantation, as well as in the firſt, the branches of the root ought not to be left too long, but to be ſhortened in ſuch a manner as to induce them to form a globular root, ſufficiently ſmall to be removed with the plant; yet ſufficiently large to give it firmneſs and vigour in the plantation.

531 Method of chooſing the plants.

Having proceeded in this manner with the ſeed-bed, our author gives the following directions. "Select from among the ſeedlings the plants whoſe wood and leaves wear the moſt *apple-like* appearance. Tranſplant theſe into a rich deep ſoil in a genial ſituation, letting them remain in this nurſery until they begin to bear. With the ſeeds of the faireſt, richeſt, and beſt flavoured fruit repeat this proceſs; and at the ſame time, or in due ſeaſon, engraft the wood which produced this fruit on that of the richeſt, ſweeteſt, beſt-flavoured apple: repeating this operation, and transferring the ſubject under improvement from one tree and ſort to another, as richneſs, flavour, or firmneſs may require; continuing this double mode of improvement until the deſired fruit be obtained. There has, no doubt, been a period when the improvement of the apple and pear was attended to in this country; and ſhould not the ſame ſpirit of improvement revive, it is probable that the country will, in a courſe of years, be left deſtitute of valuable kinds of theſe two ſpecies of fruit; which, though they may in ſome degree be deemed objects of luxury, long cuſtom ſeems to have ranked among the neceſſaries of life."

532 Mr Grimwood's opinion of the degeneracy of apples.

In the fourth volume of Bath Papers, Mr Grimwood ſuppoſes the degeneracy of apples to be rather imaginary than real. He ſays, that the evil complained of "is not a real decline in the quality of the fruit, but in the tree; owing either to want of health, the ſeaſon, ſoil, mode of planting, or the ſtock they are grafted on, being too often raiſed from the ſeed of apples in the ſame place or county. I have not a doubt in my own mind, but that the trees which are grafted on the ſtocks raiſed from the apple pips are more tender than thoſe grafted on the real crab-ſtock; and the ſeaſons in this country have, for many years paſt, been unfavourable for fruits, which add much to the ſuppoſed degeneracy of the apple. It is my opinion, that if planters of orchards would procure the trees grafted on real crab-ſtocks from a diſtant country, they would find their account in ſo doing much overbalance the extra expence of charge and carriage.

533 Mr Gillingwater's opinion.

In the ſame volume, Mr Edmund Gillingwater aſſigns as a reaſon for the degeneracy of apples the mixture of various farina, from the orchards being too near each other. In conſequence of this notion, he

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he alſo thinks that the old and beſt kinds of apple trees are not loſt, but only corrupted from being planted too near bad neighbours: "Remove them (ſays he) to a ſituation where they are not expoſed to this inconvenience, and they will immediately recover their former excellency." This theory, however, is not ſupported by a ſingle experiment.

534 Mr Samuel's opinion of the method of recovering the beſt fruit.

In this volume alſo Mr Richard Samuel expreſſes his concern at the "preſent neglect of orchards, where the old trees are decaying, without proper proviſion being made for the ſucceeding age: for if a farmer plants freſh trees (which does not frequently happen), there is ſeldom any care taken to propagate the better ſorts, as his grafts are uſually taken promiſcuouſly from any ordinary kind moſt eaſily procured in the neighbourhood." His remedy is to collect grafts from the beſt trees; by which means he ſuppoſes that the ſuperior kinds of fruit would ſoon be recovered. To a care of this kind he attributes the ſuperiority of the fruit in the neighbourhood of great towns to that in other places.

535 Cultivation, &c. of fruit trees.

With regard to the method of cultivating fruit trees, it is only neceſſary to add, that while they remain in the nurſery, the intervals betwixt them may be occupied by ſuch kitchen-ſtuff as will not crowd or overſhadow the plants; keeping the rows in the mean time perfectly free from weeds. In pruning them, the leader ſhould be particularly attended to. If they ſhoot double, the weaker of the contending branches ſhould be taken off; but if the leader be loſt, and not eaſily recoverable, the plant ſhould be cut down to within a hand's breadth of the ſoil, and a freſh ſtem trained. The undermoſt boughs ſhould be taken off by degrees, going over the plants every winter; but taking care to preſerve heads of ſufficient magnitude not to draw the ſtems up too tall, which would make them feeble in the lower part. The ſtems in Herefordſhire are trained to ſix feet high; but our author prefers ſeven, or even half a rod in height. A tall-ſtemmed tree is much leſs injurious to what grows below it than a low-headed one, which is itſelf in danger of being hurt, at the ſame time that it hurts the crop under it. The thickneſs of the ſtem ought to be in proportion to its height; for which reaſon a tall ſtock ought to remain longer in the nurſery than a low one. The uſual ſize at which they are planted out in Herefordſhire is from four to ſix inches girt at three feet high; which ſize, with proper management, they will reach in ſeven or eight years. The price of theſe ſtocks in Herefordſhire is 1s. 6d. each. Our author met with one inſtance of crabſtocks being gathered in the woods with a good proſpect of ſucceſs.

536 Method of managing the ground of orchards in Herefordſhire and Glouceſterſhire.

In Herefordſhire it is common to have the ground of the orchards in tillage, and in Glouceſterſhire in graſs; which Mr Marſhall ſuppoſes to be owing to the difference betwixt the ſoil of the two counties; that of Herefordſhire being generally arable, and Glouceſter graſs land. Trees, however, are very deſtructive, not only to a crop of corn, but to clover and turnips; though tillage is favourable to fruit trees in general, eſpecially when young. In graſs grounds their progreſs is comparatively ſlow, for want of the earth being ſtirred about them, and by being injured by the cattle, eſpecially when low-headed and drooping. After they begin to bear, cattle ought by all means to be kept away from them, as they not only deſtroy all the fruit within their reach, but the fruit itſelf is dangerous to the cattle, being apt to ſtick in their throats and choak them. Theſe inconveniences may be avoided, by eating the fruit grounds bare before the gathering ſeaſon, and keeping the boughs out of the way of the cattle: but Mr Marſhall is of opinion, that it is wrong to plant orchards in graſs land. "Let them (ſays he) lay their old orchards to graſs; and if they plant, break up their young orchards to arable. This will be changing the courſe of huſbandry, and be at once beneficial to the land and the trees.

537 Indolence of the farmers in theſe parts complained of.

Our author complains very much of the indolent and careleſs method in which the Herefordſhire and Glouceſterſhire farmers manage their orchards. The natural enemies of fruit trees (he ſays) are, 1. A redundancy of wood. 2. The miſletoe. 3. Moſs. 4. Spring froſts. 5. Blights. 6. Inſects. 7. An exceſs of fruit. 8. Old age.

538 Exceſs of wood how remedied.

1. A redundancy of wood is prejudicial, by reaſon of the barren branches depriving thoſe which bear fruit of the nouriſhment which ought to belong to them. A multitude of branches alſo give the winds ſuch an additional power over the tree, that it is in perpetual danger of being overthrown by them: trees are likewiſe thus injured by the damps and want of circulation of air, ſo that only the outer branches are capable of bringing fruit to maturity. "It is no uncommon ſight (ſays he) to ſee trees in this diſtrict, with two or three tires of boughs preſſing down hard upon one another, with their twigs ſo intimately interwoven, that even when the leaves are off, a ſmall bird can ſcarcely creep in among them.

539 Miſletoe how deſtroyed.

2. The miſletoe in this country is a great enemy to the apple tree. It is eaſily pulled out with hooks in froſty weather, when, being brittle, it readily breaks off from the branches. It likewiſe may be applied to a profitable purpoſe, ſheep being as fond of it as of ivy.

540 Moſs on fruit trees.

3. Moſs can only be got the better of by induſtry in clearing the trees of it; and in Kent there are people who make it their profeſſion to do ſo.

541 Spring-froſts.

4. Spring-froſts, eſpecially when they ſuddenly ſucceed rain, are great enemies to fruit trees; dry froſts only keep back the bloſſoms for ſome time. Art can give no farther aſſiſtance in this caſe than to keep the trees in a healthy and vigorous ſtate, ſo as to enable them to throw out a ſtrength of bud and bloſſom; and by keeping them thin of wood, to give them an opportunity of drying quickly before the froſt ſet in.

542 Blights an uncertain term.

5. Blight is a term, as applied to fruit trees, which Mr Marſhall thinks is not underſtood. Two bearing years, he remarks, ſeldom come together; and he is of opinion, that it is the mere exhauſting of the trees by the quantity of fruit which they have carried one year, that prevents them from bearing any the next. The only thing therefore that can be done in this caſe is, to keep the trees in as healthy and vigorous a ſtate as poſſible.

543 Method propoſed of deſtroying waſps.

6. Inſects deſtroy not only the bloſſoms and leaves, but ſome of them alſo the fruit, eſpecially pears. In the year 1783 much fruit was deſtroyed by waſps. Mr Marſhall adviſes to ſet a price upon the female waſps in the ſpring; by which theſe miſchievous inſects would perhaps be exterminated, or at leaſt greatly leſſened.

3

7. An

7. An exceſs of fruit ſtints the growth of young trees, and renders all in general barren for two or three years; while in many caſes the branches are broken

544 Of an exceſs of fruit.

off by the weight of the fruit; and in one caſe Mr Marſhall mentions, that an entire tree had ſunk under its burden. To prevent as much as poſſible the bad effects of an exceſs of fruit, Mr Marſhall recommends "to graft in the boughs," and when fully grown, to thin the bearing branches; thus endeavouring, like the gardener, to grow fruit every year."

545 Duration of fruit trees may be lengthened.

8. Though it is impoſſible to prevent the effects of old age, yet by proper management the natural life of fruit trees may be conſiderably protracted. The moſt eligible method is to graft ſtocks of the native crab in the boughs. The decline of the tree is preceded by a gradual decline of fruitfulneſs, which takes place long before the tree manifeſts any ſign of decay. During this decline of fruitfulneſs, there is a certain period when the produce of a tree will no longer pay for the ground it occupies; and beyond this period it ought by no means to be allowed to ſtand. In the Vale of Glouceſter, however, our author ſaw an inſtance of ſome healthy bearing apple trees, which then had the *ſecond* tops to the ſame ſtems. The former tops having been worn out, were cut off, and the ſtumps ſaw-grafted. Our author obſerves, that the pear tree is much longer lived than the apple, and ought never to be planted in the ſame ground. He concludes with the following general obſervation: "Thus conſidering fruit trees as a crop in huſbandry, the general management appears to be this: Plant upon a recently broken-up worn-out ſward. Keep the ſoil under a ſtate of arable management, until the trees be well grown: then lay it down to graſs, and let it remain in ſward until the trees be removed, and their roots be decayed: when it will again require a courſe of arable management."

546 Mr Marſhall's obſervation on the culture of fruit trees.

Sect. VIII. *Of Timber Trees.*

The importance and value of theſe are ſo well known, that it is ſuperfluous to ſay any thing on that ſubject at preſent: notwithſtanding this acknowledged value, however, the growth of timber is ſo ſlow, and the returns for planting ſo diſtant, that it is generally ſuppoſed for a long time to be a poſitive loſs, or at leaſt to be attended with no profit. This matter, however, when properly conſidered, will appear in another light.

547 Different kinds of woodlands.

There are four diſtinct ſpecies of woodlands; *viz.* woods, timber groves, coppices, and woody waſtes. The woods are a collection of timber trees and underwood; the timber groves contain timber trees without any underwood; and the coppices are collections of underwood alone. All theſe turn out to advantage ſooner or later, according to the quick or ſlow growth of the trees, and the ſituation of the place with reſpect to certain local advantages. Thus in ſome places underwood is of great conſequence, as for rails, hoops, ſtakes, fuel, &c. and by reaſon of the quickneſs of its growth it may be accounted the moſt profitable of all plantations.

548 What plantation will ſooneſt bring in a return of profit.

An oſier-bed will yield a return of profit the ſecond or third year, and a coppice in 15 or 20 years; while a plantation of oaks will not arrive at perfection in leſs than a century. This laſt period is ſo long, that it may not unreaſonably be ſuppoſed likely to deter people from making plantations of this kind, as few are willing to take any trouble for what they are never to ſee in perfection. It muſt be remembered, however, that though the trees themſelves do not come to perfection in a ſhorter time, the value of the ground will always increaſe in proportion

549 Advantages of planting.

to their age. Thus, ſays one author upon this ſubject, "we have ſome knowledge of a gentleman now living, who during his lifetime has made plantations, which in all probability will be worth to his ſon as much as his whole eſtate, handſome as it is. Suppoſing that thoſe plantations have been made 50 or 60 years, and that in the courſe of 20 or 30 more they will be worth 50,000l; may we not ſay, that at preſent they are worth ſome 20,000l. or 30,000l.? Mr Pavier, in the 4th volume of Bath Papers, computes the value of 50 acres of oak timber in 100 years to be 12,100l. which is nearly 50s. annually *per* acre; and if we conſider that this is continually accumulating, without any of that expence or riſk to which annual crops are ſubject, it is probable that timber planting may be accounted one of the moſt profitable articles in huſbandry. Evelyn calculates the profit of 1000 acres of oak-land in 150 years, at no leſs than 670,000l.; but this is moſt probably an exaggeration. At any rate, however, it would be improper to occupy, eſpecially with timber of ſuch ſlow growth, the grounds which either in graſs or corn can repay the trouble of cultivation with a good annual crop.

550 Planting meliorates the ſoil.

In the fourth volume of the Bath Papers, Mr Wagſtaffe recommends planting as an auxiliary to cultivation. He brings an inſtance of the ſucceſs of Sir William Jerringham, who made trial of "the moſt unpromiſing ground perhaps that any ſucceſsful planter has hitherto attempted." His method was to plant beech trees at proper diſtances among Scotch firs, upon otherwiſe barren heaths. "Theſe trees (ſays Mr Wagſtaffe), in a ſoil perhaps without clay or loam, with the heathy ſod trenched into its broken ſtrata of ſand or gravel, under the protection of the firs, have laid hold, though ſlowly, of the ſoil; and accelerated by the ſuperior growth of the firs, have proportionally riſen, until they wanted an enlargement of ſpace for growth, when the firs were cut down." He next proceeds to obſerve, that when the firs are felled, their roots decay in the ground; and thus furniſh by that decay a new ſupport to the ſoil on which the beeches grow: by which means the latter receive an additional vigour, as well as an enlargement of ſpace and freer air; the firs themſelves, though cut down before they arrived at their full growth, being alſo applicable to many valuable purpoſes.

551 Culture of timber trees recommended by Mr Harries.

In the 6th volume of Annals of Agriculture, we find the culture of trees recommended by Mr Harries: and he informs us, that the larch is the quickeſt grower and the moſt valuable of all the reſinous timber trees; but unleſs there be pretty good room allowed for the branches to ſtretch out on the lower part of the trunk, it will not arrive at any conſiderable ſize; and this obſervation, he ſays, holds good of all pyramidal trees. Scotch firs may be planted between them, and pulled out after they begin to obſtruct the growth of the larch. Some of theſe larches he had ſeen planted about 30 years before, which at 5 feet diſtance from the ground meaſured from 4 feet to 5 feet 6 inches in circumference.

Timber Trees.

ence. The moſt barren grounds, he ſays, would anſwer for theſe trees, but better ſoil is required for the oaks. In this paper he takes notice of the leaves of one of his plantations of oaks having been almoſt entirely deſtroyed by inſects; in conſequence of which they did not increaſe in bulk as uſual: but another which had nearly eſcaped theſe ravages, increaſed at an average 1 inch in circumference. "A tree 4 feet round (ſays he), that has timber 20 feet in length, gains by this growth a ſolid foot of timber annually, worth one ſhilling at leaſt, and pays 5 *per cent.* for ſtanding. It increaſes more as the tree gets from 5 to 6 feet round. I have a reaſonable hope to infer from my inquiry, that I have in my groves 3000 oaks that pay me one ſhilling each *per annum*, or 150l. a-year. My poplars have gained in circumference near two inches, and a Worceſter and witch elm as much. I have lately been informed, that the ſmooth cut of a holly tree, that meaſures 20 inches and upwards round, is worth to the cabinet-makers 2s. 6d *per* foot.

552 Increaſe of oak trees.

553 Increaſe of trees in the marquis of Lanſdowne's plantation.

The following table ſhows the increaſe of trees in 21 years from their firſt planting. It was taken from the marquis of Lanſdowne's plantation, begun in the year 1765, and the calculation made on the 15th of July 1786. It is about ſix acres in extent, the ſoil partly a ſwampy meadow upon a gravelly bottom. The meaſures were taken at 5 feet above the ſurface of the ground; the ſmall firs having been occaſionally drawn for poſts and rails, as well as rafters for cottages; and when peeled of the bark, will ſtand well for ſeven years.

	Height in Feet.	Circumference in Feet.	Inch.
Lombardy poplar -	60 to 80	4	8
Arbeal - -	50 to 70	4	6
Plane - -	50 to 60	3	6
Acacia - -	50 to 60	2	4
Elm - -	40 to 60	3	6
Cheſnut - -	30 to 50	2	9
Weymouth pines -	30 to 50	2	5
Cluſter ditto -	30 to 50	2	5
Scotch fir -	30 to 50	2	10
Spruce ditto -	30 to 50	2	2
Larch - -	50 to 60	3	10

From this table it appears, that planting of timber-trees, where the return can be waited for during the ſpace of 20 years, will undoubtedly repay the original profits of planting, as well as the intereſt of the money laid out; which is the better worth the attention of a proprietor of land, as the ground on which they grow may be ſuppoſed good for very little elſe. From a comparative table of the growth of oak, aſh, and elm timber, given in the 11th volume of the Annals of Agriculture, it appears that the oak is by much the ſloweſt grower of the three.

554 Of underwood, &c.

With reſpect to the growth of underwood, which in ſome caſes is very valuable, it is to be remarked, that in order to have an annual fall of it, the whole quantity of ground, whatever its extent may be, ought to be divided into annual ſowings. The exact number of ſowings muſt be regulated by the uſes to which it is intended to be put. Thus if, as in Surrey, ſtakes, edders, and hoops are ſaleable, there ought to be eight or ten annual ſowings; or, if, as in Kent, hop-poles are demanded, 14 or 15 will be required; and if, as in Yorkſhire, rails be wanted, or, as in Glouceſterſhire, cordwood be moſt marketable, 18 or 20 ſowings will be neceſſary to produce a ſucceſſion of annual falls. Thus the buſineſs, by being divided, will be rendered leſs burthenſome: a certain proportion being every year to be done, a regular ſet of hands will, in proper ſeaſon, be employed; and by beginning upon a ſmall ſcale, the errors of the firſt year will be corrected in the practice of the ſecond, and thoſe of the ſecond in that of the third. The produce of the intervals will fall into regular courſe; and when the whole is completed, the falls will follow each other in regular ſucceſſion. The greateſt objection to this method of ſowing woodlands is the extraordinary trouble in fencing: but this objection does not hold if the ſowings lie at a diſtance from one another; on the contrary, if they lie together, or in plots, the entire plot may be incloſed at once; and if it contain a number of ſowings, ſome ſubdiviſions will be neceſſary, and the annual ſowings of theſe ſubdiviſions may be fenced off with hurdles, or ſome other temporary contrivance; but if the adjoining land be kept under the plough, little temporary fencing will be neceſſary. It muſt be obſerved, however, that in raiſing a woodland from ſeeds, it is not only neceſſary to defend the young plants againſt cattle and ſheep, but againſt hares and rabbits alſo: ſo that a cloſe fence of ſome kind is abſolutely neceſſary.

With regard to the preparation of the ground for raiſing timber, it may be obſerved, that if the ſoil be of a ſtiff clayey nature, it ſhould receive a whole year's fallow as for wheat; if light, a crop of turnips may be taken; but at all events it muſt be made perfectly clean before the tree ſeeds be ſown, particularly from perennial root weeds; as, after the ſeeds are ſown, the opportunity of performing this neceſſary buſineſs is in a great meaſure loſt. If the ſituation be moiſt, the ſoil ſhould be gathered into wide lands, ſufficiently round to let the water run off from the ſurface, but not high. The time of ſowing is either the month of October or March; and the method as follows: "The land being in fine order, and the ſeaſon favourable, the whole ſhould be ſown with corn or pulſe adapted to the ſeaſon of ſowing: if in autumn, wheat or rye may be the crop; but if in ſpring, beans or oats. Whichever of theſe three ſpecies be adopted, the quantity of ſeed ought to be leſs than uſual, in order to give a free admiſſion of air, and prevent the crop from lodging. The ſowing of the grain being completed, that of the tree-ſeeds muſt be immediately ſet about. Theſe are to be put in drills acroſs the land: acorns and nuts ſhould be dibbled in, but keys and berries ſcattered in trenches or drills drawn with the corner of a hoe, in the manner that gardeners ſow their peaſe. The diſtance might be a quarter of a ſtatute rod, or four feet and one inch and a half. A land-chain ſhould be uſed in ſetting out the drills, as not being liable to be lengthened or ſhortened by the weather. It is readily divided into rods; and the quarters may be eaſily marked.

555 Method of ſowing.

The ſpecies of underwood to be ſown muſt be determined by the conſumpt of it in the neighbourhood of the plantation. Thus, if ſtakes, hoops, &c. be in requeſt, the oak, hazel, and aſh, are eſteemed:

as

Timber Trees.

as underwood. Where charcoal is wanted for iron forges, beech is the prevailing underwood. The oak, box, birch, &c. are all in requeſt in different countries, and the choice muſt be determined by the prevailing demand. As the keys of the aſh ſometimes lie two or even three years in the ground, it will be proper to have the places where they are ſown diſtinguiſhed by ſome particular marks, to prevent them from being diſturbed by the plough after harveſt; as a few beans ſcattered along with them, if the crop be oats; or oats, if the crop be beans. The crop ſhould be *reaped*, not *mown*, at harveſt time, and be carried off as faſt as poſſible. Between harveſt and winter, a pair of furrows ſhould be laid back to back in the middle of each interval, for meliorating the next year's crop, and laying the ſeedling plants dry; while the ſtubble of the unploughed ground on each ſide of the drills will keep them warm during the winter. The next year's crop may be potatoes, cabbages, turnips, or if the firſt was corn, this may be beans; if the firſt was beans, this may be wheat drilled. In the ſpring of the third year the drills which roſe the firſt year muſt be looked over, and the vacancies filled up from thoſe parts which are thickeſt; but the drills of the aſh ſhould be let alone till the fourth year. The whole ſhould afterwards be looked over from time to time; and this, with cultivating the intervals, and keeping the drills free from weeds, will be all that is neceſſary until the tops of the plants begin to interfere.

The crops may be continued for ſeveral years; and if they only pay for the expences, they will ſtill be of conſiderable advantage by keeping the ground ſtirred, and preſerving the plants from hares and rabbits. Even after the crops are diſcontinued, the ground ought ſtill to be ſtirred, alternately throwing the mould to the roots of the plants, and gathering it into a ridge in the middle of the interval. The beſt method of doing this is to ſplit the ground at the approach of winter in order to throw it up to the trees on both ſides; this will preſerve the roots from froſt: gather it again in the ſpring, which will check the weeds, and give a freſh ſupply of air: ſplit again at midſummer, to preſerve the plants from drought: gather, if neceſſary, in autumn, and ſplit as before at the approach of winter. The ſpring and midſummer ploughings ſhould be continued as long as a plough can paſs between the plants.

Whenever the oaks intended for timber are in danger of being drawn up too ſlender for their height, it will be neceſſary to cut off all the reſt at the height of about an handbreadth above the ground; and thoſe deſigned to ſtand muſt now be planted at about two rods diſtant from each other, and as nearly a quincunx as poſſible. The ſecond cutting muſt be determined by the demand there is for the underwood; with only this proviſo, that the timber ſtands be not too much crowded by it; for rather than this ſhould be the caſe, the coppice ſhould be cut, though the wood may not have reached its moſt profitable ſtate. What is here ſaid of the method of rearing oak trees in woods, is in a great meaſure applicable to that of raiſing other trees in timber groves. The ſpecies moſt uſually raiſed in theſe are the aſh, elm, beech, larch, ſpruce fir, Weymouth pine, poplar, willow, alder, cheſnut, walnut, and cherry. The three laſt are uſed as ſubſtitutes for the oak and beech, and theſe two for the mahogany.

The following account of the mode of planting that was adopted by the earl of Fife, for no leſs than 550 acres of mooriſh lands, is worthy of attention. It is contained in a letter from his lordſhip to the publiſher of the Annals of Agriculture. "Where there are ſtones in the moor, I incloſe with a ſtone wall five feet high, coped with two turfs, which coſt about 15s. every Scots chain of 24 ells, and where there are no ſtones, which is moſtly the caſe in the moors in the county of Murray, I incloſe with a fence of turf, five feet high, four feet wide at the foundation, and 22 inches at top, at 4s. the Scots chain. I find thoſe fences anſwer as well as the ſtone, for there are many of them now above 20 years old, as good as at firſt. I plant in every acre about 1200 trees. I uſed to plant above 3000, but by experience I find it better not to plant them ſo thick, but make them up, if neceſſary, the third year (eſpecially in my plantations in the county of Murray), where ſcarcely a tree planted ever fails. The greateſt number of the trees are Scots firs raiſed by myſelf, or purchaſed at 10d. the thouſand, planted from the ſeed-bed at three years old. I only conſider them as nurſes to my other trees, for they are regularly cut out when they have done their duty as nurſes, and are profitable for fire, and uſeful in agriculture. I plant every other ſpecies of foreſt trees intermixed with the firs. I order different pieces of the moor to be trenched where the ſoil is beſt, and moſt ſheltered, and lay a little lime and dung on it, and in theſe places I ſow ſeeds of trees for nurſery. I alſo plant in beds, year-old trees of different kinds, taken from my other nurſeries. I nurſe them for three years, and then plant them all over the plantation: this I find very beneficial, as they are raiſed in the ſame ſoil. When I am filling up the plantations, the firs are, for the firſt time, cut down; or they are tranſplanted, being raiſed with balls of earth when the moor is wet with rain, which is very eaſily done, and they are carried to incloſures of ten or twelve acres, where, from a deſire of forward woods, I am planting trees more advanced. They are planted in pits about 40 feet diſtance, and ſeldom or never fail, and anſwer a ſecond time as nurſes.

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Earl of Fife's plantations.

"My firſt care after the incloſure is properly filled up, is to guard againſt injury from cattle: a ſmall allowance given to a few labourers anſwers that purpoſe, and if the fences are properly executed they require very little repair. After the plantation is filled up, the moſt regular attention muſt be had to the weeding of it, and this is carried on over my plantations of all ages in the moſt exact manner; I make roads through all the plantations which are carried forward according to the ſituation, never in a ſtraight line ſo as to draw violent winds, and thoſe roads go to all parts of the plantation; they make agreeable rides through fine woods, formerly a bleak moor, and anſwer not only for filling up, but alſo for carrying away the neceſſary weedings. As I obſerved before, the value and proſperity of the wood depends upon the unremitted attention in weeding it.

"I begin to plant in October, and continue till April. If the weather is froſty and not fit for planting, all the people are employed in weeding the woods."

It is proper, however, upon this ſubject to remark, that

Cattle proper to be employed.

557 Where plantations are eligible or otherwise.

that the value of plantations of timber trees, as connected with other branches of agriculture, is not a little limited. In a mountainous country, and in bleak moorish situations, nothing tends more to increase the value of the soil, than plantations properly distributed. They give shelter both to the cattle and to the corn crops; and by preventing the warmth which is produced by proper manures, and by the germination of vegetables, from being dissipated, they give effect to all the efforts of industry. Accordingly, in such situations, plantations are no sooner reared, than the whole face of the country around them assumes an improving aspect, and displays a richer verdure. When suddenly cut down, in consequence of the necessities of an improvident proprietor, the reverse of all this occurs. Vegetation is chilled by the piercing blasts which now meet with no resistance, and the cattle droop from want of shelter; so that in a few years the place can scarcely be known. But the case is very different with regard to a rich and level country that is meant to be cultivated for corn. There the effect of numerous plantations, of high trees and lofty hedge rows, is altogether distressing to the husbandman. It is only in open fields that grain appears well ripened and completely filled. When surrounded with timber trees, on the contrary, it ripens ill, and is ill coloured and unequal. In spring the high shelter prevents the grounds from drying, and keeps back the labour. In summer the crop is liable to diseases from want of air, and is devoured by large flocks of small birds. In autumn, from want of a free circulation of air the corn ripens late, and in a weeping climate it can never be gathered in good condition. In wet seasons it is utterly ruined. In winter, when the snow is drifting about, the trees prepare a resting place for large quantities of it; these frequently remain and stop the spring work. Add to this, that in a low country even the cattle are hurt by the swarms of vermin that are bred, and come forth, under the shelter of lofty trees and high fences.

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PART III. OF THE CATTLE PROPER TO BE EMPLOYED IN FARM WORK; REARING AND MANAGEMENT OF THEM. OF HOGS, POULTRY, &c. OF THE DAIRY. MAKING OF FRUIT LIQUORS. OF FENCES.

SECT. I. *Of the Cattle proper to be employed.*

As great part of the stock of a husbandman must always consist of cattle, and as one of his principal expences must consist of the maintenance of them, this part of his business is certainly to be looked upon as extremely important. The cattle belonging to a a farm may be divided into two classes, viz. such as are intended for work, and such as are designed for sale. The former are now principally horses, the oxen formerly employed being fallen into disuse, though it does not yet certainly appear that the reasons for the ex-

558 Mr Kedington's experiment on the comparative utility of horses and oxen.

change are satisfactory. In the second volume of Bath Papers, we have an account of a comparative experiment of the utility of horses and oxen in husbandry by Mr Keddington near Bury in Suffolk, in which the preference is decisively given to oxen. He informs us, that at the time he began the experiment (in 1779), he was almost certain that there was not an ox worked in the whole county; finding, however, the expence of horses very great, he purchased a single pair of oxen, but found much difficulty in breaking them, as the workmen were so much prejudiced against them, that they would not take the proper pains. At last he met with a labourer who undertook the task; and the oxen "soon became as tractable and as handy, both at ploughing and carting, as any horses." On this he determined to part with all his cart-horses; and by the time he wrote his letter, which was in 1781, he had not a single horse, nor any more than six oxen; which inconsiderable number performed with ease all the work of his farm (consisting of upwards of 100 acres of arable land and 60 of pasture and wood), besides the statute duty on the highways, timber and corn carting, harrowing, rolling, and every part of rural business. They are constantly shoed; their harness is the same as that of horses (excepting the necessary alterations for difference of size and shape); they are driven with bridles and bits in their mouths, answering to the same words of the ploughman and carter as horses will do. A single man holds the plough, and drives a pair of oxen with reins: and our author informs us, that they will plough an acre of ground in less than eight hours time; he is of opinion that they could do it in seven. The intervals of a small plantation, in which the trees are set in rows ten feet asunder, are ploughed by a single ox with a light plough, and he is driven by the man who holds it. The oxen go in a cart either single, or one, two, or three, according to the load. Four oxen will draw 80 bushels of barley or oats in a waggon with ease; and if good of their kind, will travel as fast as horses with the same load. One ox will draw 40 bushels in a light cart, which our author thinks is the best carriage of any. On the whole, he prefers oxen to horses for the following reasons.

559 Reasons for preferring oxen to horses.

1. They are kept at much less expence, never eating meal or corn of any kind. In winter they are fed with straw, turnips, carrots, or cabbages; or instead of the three last, they have each a peck of bran per day while kept constantly at work. In the spring they eat hay; and if working harder than usual in seed-time, they have bran besides. When the vetches are fit for mowing, they get them only in the stable. After the day's work in summer they have a small bundle of hay, and stand in the stable till they cool; after which they are turned into the pasture. Our author is of opinion, that an ox may be maintained in condition for the same constant work as a horse, for at least 4l. less annually.

2. After a horse is seven years old, his value declines every year; and when lame, blind, or very old, he is scarce worth any thing; but an ox, in any of these situations, may be fatted, and sold for even more than the first purchase; and will always be fat sooner after work than before.

3. Oxen are less liable to diseases than horses.

4. Horses are frequently liable to be spoiled by ser-

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vants riding them without their master's knowledge, which is not the case with oxen.

5. A general use of oxen would make beef plentiful, and consequently all other meat; which would be a national benefit.

560 Difficulty in shoeing oxen.

Mr Kedington concludes his paper with acknowledging, that there is one inconvenience attending the use of oxen, viz. that it is difficult to shoe them; though even this, he thinks, is owing rather to the unskilfulness of the smiths who have not been accustomed to shoe these animals, than to any real difficulty. He confines them in a pound while the operation is performing.

561 Mr Marshall's calculations.

Mr Marshall, in his Rural Economy of the Midland Counties, shows the advantage of employing oxen in preference to horses from the mere article of expence, which, according to his calculation, is enormous on the part of the horses. He begins with estimating the number of square miles contained in the kingdom of England; and this he supposes to be 30,000 of cultivated ground. Supposing the work of husbandry to be done by horses only, and each square mile to employ 20 horses, which is about 3 to 100 acres, the whole number used throughout Britain would be 600,000; from which deducting one sixth for the number of oxen employed at present, the number of horses just now employed will be 500,000. Admitting that each horse works ten years, the number of farm-horses which die annually are no fewer than 50,000; each of which requires full four years keep before he is fit for work. Horses indeed are broke in at three, some at two, years old, but they are, or ought to be, indulged in keep and work till they are six; so that the cost of rearing and keeping may be laid at full four ordinary years. For all this consumption of vegetable produce he returns not the community a single article of food, clothing, or commerce; even his skin for economical purposes being barely worth the taking off.

562 A million annually lost by keeping horses.

By working horses in the affairs of husbandry, therefore, "the community is losing annually the amount of 200,000 years keep of a growing horse;" which at the low estimate of five pounds a-year, amounts to a million annually. On the contrary, supposing the business of husbandry to be done solely by cattle, and admitting that oxen may be fatted with the same expenditure of vegetable produce as that which old horses require to fit them for full work, and that instead of 50,000 horses dying, 50,000 oxen, of no more than 52 stone each, are annually slaughtered; it is evident, that a quantity of beef nearly equal to what the city of London consumes would be annually brought into the market; or, in other words, 100,000 additional inhabitants might be supplied with one pound of animal food a-day each; and this without consuming one additional blade of grass. "I am far from expecting (says Mr Marshall), that cattle will, in a short space of time, become the universal beasts of draught in husbandry; nor will I contend, that under the present circumstances of the island they ought in strict propriety to be used. But I know that cattle, under proper management, and kept to a proper age, are equal to every work of husbandry, in most, if not all situations: And I am certain, that a much greater proportion than there is at present might be worked with considerable advantage, not to the community only, but to the owners and occupiers of lands. If only one of the 50,000 carcases now lost annually to the community could be reclaimed, the saving would be an object."

Cattle proper to be employed.

563 No oxen used in Norfolk.

In Norfolk, our author informs us, that horses are the only beasts of labour; and that there is not perhaps one ox worked throughout the whole county.

564 Objection to them in the Vale of Gloucester.

It is the same in the Vale of Gloucester, though oxen are used in the adjoining counties. Formerly some oxen were worked in it double; but they were found to poach the land too much, and were therefore given up. Even when worked single, the same objection is made: but, says Mr Marshall, "in this I suspect there is a spice of obstinacy in the old way; a want of a due portion of the spirit of improvement; a kind of indolence. It might not perhaps be too severe to say of the Vale farmers, that they would rather be eaten up by their horses than step out of the beaten track to avoid them." Shoeing oxen with whole shoes, in our author's opinion, might remedy the evil complained of; "but if not, let those (says he) who are advocates for oxen, calculate the comparative difference in *wear* and keep, and those who are their enemies estimate the comparative mischiefs of treading; and thus decide upon their value as beasts of labour in the Vale."

565 Used in the Cotswold.

In the Cotswold oxen are worked as well as horses; but the latter, our author fears, are still in the proportion of two to one: he has the satisfaction to find, however, that the former are coming into more general use. They are worked in harness; the collar and harness being used as for horses, not reversed, as in most cases they are for oxen. "They appear (says our author) to be perfectly handy; and work, either at plough or cart, in a manner which shows, that although horses may be in some cases *convenient*, and in most cases *pleasurable to the driver*, they are by no means *necessary* to husbandry.

566 Moveable harness-houses.

A convenience used in this country is a moveable *harness-house* with a sledge bottom, which is drawn from place to place as occasion may require. Thus no labour is lost either by the oxen or their drivers.

567 Why the use of oxen is declining in Yorkshire.

In Yorkshire oxen are still used, though in much fewer numbers than formerly; but our author does not imagine this to be any decisive argument against their utility. The Yorkshire plough was formerly of such an unwieldy construction, that four or six oxen, in yokes, led by two horses, were absolutely requisite to draw it; but the improvements in the construction of the plough have of late been so great, that two horses are found to be sufficient for the purpose; so that as Yorkshire has all along been famous for its breed of horses, we are not to wonder at the present disuse of oxen. Even in carriages they are now much disused; but Mr Marshall assigns as a reason for this, that the roads were formerly deep in winter, and soft to the hoof in summer; but now they are universally a causeway of hard limestones, which hurt the feet of oxen even when shod. Thus it even appears matter of surprise to our author that so many oxen are employed in this county; and the employment of them at all is to him a convincing argument of their utility as beasts of draught. The timber carriers still continue to use them, even though their employment be solely upon the road. They find them not only able to stand working every day, provided their feet do not fail them, but

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but to bear long hours better than horſes going in the ſame paſture. An ox in a good paſture ſoon fills his belly, and lies down to reſt; but a horſe can ſcarce ſatisfy his hunger in a ſhort ſummer's night. Oxen are

568 Superiority of oxen to horſes.

alſo conſidered as much ſuperior at a difficult pull to horſes; but this he is willing to ſuppoſe ariſes from their uſing half-bred hunters in Yorkſhire, and not the true breed of cart horſes. "But what (ſays he) are thorough-bred cart horſes? Why, a ſpecies of ſtrong, heavy, ſluggiſh animals, adapted ſolely to the purpoſe of draught; and according to the preſent law of the country, cannot, without an annual expence, which nobody beſtows upon them, be uſed for any other purpoſe. This ſpecies of beaſts of draught coſt at four years old from 20l. to 30l. They will, with extravagant keep, extraordinary care and attendance, and much good luck, continue to labour eight or ten years; and may then generally be ſold for five ſhillings a-head. If we had no other ſpecies of animals adapted to the purpoſes of draught in the iſland, cart horſes would be very valuable, they being much ſuperior to the breed of ſaddle horſes for the purpoſe of draught. But it appears evident, that were only a ſmall ſhare of the attention paid to the breeding of draught oxen which is now beſtowed on the breeding of cart horſes, animals equally powerful, more active, leſs coſtly, equally adapted to the purpoſes of huſbandry if harneſſed with equal judgment, leſs expenſive in keep and attendance, much more durable, and infinitely more valuable after they have finiſhed their labours, might be produced. A ſteer, like a colt, ought to be familiarized to harneſs at two or three years old, but ſhould never be ſubjected to hard labour until he be five years old; from which age until he be 15 or perhaps 20, he may be conſidered as in his prime as a beaſt of draught. An ox which I worked ſeveral years in Surrey, might at 17 or 18 years of age have challenged for ſtrength, agility, and ſagacity, the beſt bred cart horſe in the kingdom.

569 Horſes are everywhere prevailing over oxen.

Notwithſtanding all that has been ſaid, however, and written about the ſuperiority of oxen to horſes, the latter are ſtill coming into more general uſe, eſpecially in proportion as the breed of horſes improves; and we may add, in proportion as the ſtate of cultivation in any part of the country improves. The reaſon is obvious. The horſe is a more active animal than the ox, and can be turned with greater readineſs from one kind of work to another. His hoof is leſs readily injured by the hardneſs of good roads; and for the uſe of the plough upon a well ordered farm, there is no compariſon between the two kinds of animals. Where land is once brought into a proper ſtate of tillage, it is eaſily turned over; and the value of the animal employed in doing ſo conſiſts not ſo much in the poſſeſſion of great ſtrength as in the activity which he exerts in going over a great extent of ground in a ſhort time. In this laſt reſpect, a good breed of horſes ſo far ſurpaſſes every kind of oxen yet known in this country, that we ſuſpect much the horſe will ſtill continue to be preferred by enterpriſing huſbandmen.

With regard to the loſs which the public is ſuppoſed to ſuſtain by preferring horſes to oxen, that point has of late been rendered, to ſay no more, extremely doubtful. In the Agricultural Survey of the county of Northumberland, we have the following comparative ſtatement between horſes and oxen, for the purpoſe of the draught:—"By way of preliminary, it will be neceſſary to admit as data, that a horſe which eats 70 buſhels of oats per year, will not conſume of other food ſo much as an ox that gets no corn; but in the following eſtimate we ſhall allow horſes to eat as much as oxen, as the difference is not yet ſufficiently aſcertained.

570 Calculations in favour of the uſe of horſes.

"That the oxen are yoked at three years old, and are worked till ſix, and for the firſt year require eight to do the work of two horſes; but after having been worked a year, and become tractable and ſtronger, ſix are equal to two horſes, either by being yoked three at a time, or two, and driven by the holder with cords; of courſe, the expence of a driver may be eſtimated to be ſaved for one half the year.

"That the expences of a ploughman, the plough, and other articles that are the ſame in both teams need not be taken into the account.

"And that oxen to work regularly through the year, cannot work more than half a day at a time".

Expence of an Ox per annum.

Summering.—Graſs 2 acres at 20s. per acre		L. 2 0 0
Wintering.—On ſtraw and turnips	L. 2 0 0	
But if on hay	4 0 0	
The average is		3 0 0
		L. 5 0 0
Intereſt at 5 *per cent.* for price of the ox		0 10 0
Harneſs, ſhoeing, &c.		0 15 0
		6 5 0
Deduct for the increaſed value of an ox for 1 year - -		1 0 0
Gives the expence *per annum* of an ox for the team		5 5 0
And the expence of 6 oxen -		31 10 0
To which muſt be added the expence of a driver for half a year -		3 10 0
Total expence of a team of 6 oxen		L. 35 0 0

An Eight-Ox team.

The expence of an ox *per annum* being	L. 5 5 0
	8
That of eight will be	42 0 0
To which add the expence of a driver	8 0 0
Gives the expence *per annum* of an eight-ox team	L. 50 0 0
Therefore the expence of a team of oxen for the firſt year will be -	L. 50 0 0
Ditto the ſecond year - -	35 0 0
Ditto the third year - -	35 0 0
Divided by	3)120 0 0

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Brought over,			
Divided by - -	3)120	0	0
Gives the average expence *per annum* of an ox team from 3 to 6 years old	L. 40	0	0

Expence of a horse per annum.

Summering.—Grafs 2 acres at 20s. per acre - -	L. 2	0	0
Wintering.—Straw 13 weeks at 9d. per week - -	0	10	0
Hay 16 ditto $1\frac{1}{4}$ tons at 2l.	3	0	0
Corn (for a year) 70 bufhels of oats at 2l.	7	0	0
Shoeing and harnefs - -	1	0	0
Annuity to pay off 25l. in 16 years the purchafe value of the horfe at four years old - - -	2	5	0
Expence of a horfe *per annum*	L. 15	15	0
Expence of a two-horfe team	L. 31	10	0

"If a three horfe-team be ufed, the account will ftand thus:

The expence of a horfe *per annum* being	L. 15	15	0
			3
That of three will be - -	47	5	0
To which add the expence of a driver	8	0	0
Gives the expence of a three-horfe team	L. 55	5	0

"If the comparifon be made with the horfe team of many of the midland counties, where they ufe *five-horfes yoked one before another in one plough*, the account will ftand thus:

The expence of one horfe *per annum* being - - -	L. 15	15	0
			5
That of five will be - -	78	15	0
To which add the expence of a man to drive	18	0	0
The expence of a team of five horfes will be	L. 96	15	0
ditto of 3 ditto	55	5	6
ditto of 2 ditto	31	10	0
ditto of 8 oxen	50	0	0
The average expence of an ox-team from three to fix years old, that will do the fame quantity of work as two horfes	40	0	0

"The conclufions to be drawn from the above ftatement, are fo obvious as to need little elucidation. But we cannot help remarking, how ftrong the force of prejudice muft be, to continue the ufe of five horfes, and heavy, clumfy, unwieldy *wheel ploughs*, where a fingle *fwing plough* and two horfes yoked double, and driven by the holder, would do the fame quantity of work, equally well and at one half of the expence."

"But before any proper conclufion can be drawn, whether *ox teams* or *horfe* are the moft eligible, it will be neceffary to confider, whether the quantity of land employed in fupporting thofe animals, be ufed in the moft profitable mode to the community, as well as to the occupier.

Different Kinds of Horfes.

"With the latter, the firft queftion for confideration is, whether eight oxen ufed in the team or in grazing will pay him the moft money?

"Suppofe eight oxen, at *three years old*, were put to the plough, and plough fix acres per week, which, at 3s. 4d. per acre, is 20s.; and if they work forty-eight weeks in a year, their whole earnings (after deducting 6l. for expences of harnefs, fhoeing, &c.) will be 42l.; but if they plough only *five acres per week* (which is probably nearer the truth), then their whole earnings will be only 34l.

"The fame oxen put to graze at the fame money fhould improve in value 5l. 5s. each in the firft cafe, and 4l. 5s. in the latter; but we are inclined to believe there are few fituations, if the cattle are of a good quick-feeding kind, where they would not pay confiderably more.

"In refpect to the community, the account will be nearly as follows:

"From the above ftatements, we find that an ox for fummering and wintering requires	$3\frac{1}{2}$	acres
Therefore a fix-ox team will require	21	ditto
And two horfes for grafs and hay *per annum* require - - -	7	ditto
For corn and ftraw - -	4	ditto
Land neceffary for keeping two horfes *per annum* - - -	11	ditto
The difference in the quantity of land required for a team of oxen more than horfes	10	ditto.

"Hence it appears, that a team of fix oxen requires ten acres more land to maintain them, than a team of two horfes, which will do the fame work; and of courfe the produce which might be derived from thefe ten acres is loft to the community. Suppofe it be one half in grafs, the other half in tillage, then we fhall have

"5 Acres of clover or grafs,
$1\frac{2}{3}$ Ditto of oats,
$1\frac{2}{3}$ Ditto of turnips or fallow,
$1\frac{2}{3}$ Ditto of wheat.

"It would then fend to market yearly, at the loweft computation,

$7\frac{1}{2}$ cwt. of beef,
8 quarters of oats,
And 5 ditto of wheat.

"From this view of the fubject, it appears that if oxen were univerfally ufed for the draught, in the room of horfes, there would be a confiderable defalcation, in the fupply of the markets, both in corn and animal food. And the lofs to the farmer would be the profit derived from the produce; which, by the ufual mode of allowing one third for the farmer's profit, would in this cafe be about 10l."

Sect. II. *Of the different kinds of Horfes, and the Method of Breeding, Rearing, and Feeding them.*

571 Account of the black cart-horfe.

The midland counties of England have for fome time been celebrated on account of their breed of the *black cart-horfe*; though Mr Marfhall is of opinion that this kind are unprofitable as beafts of draught in hufbandry.

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bandry. The present improvement in the breed took its rise from six Zealand mares sent over by the late Lord Chesterfield during his embassy at the Hague. These mares being lodged at his lordship's seat at Bretby in Derbyshire, the breed of horses thus became improved in that county, and for some time it took the lead for the species of these animals. As the improved breed passed into Leicestershire, however, through some unknown circumstances, it became still more improved, and Leicester has for some time taken the lead. It is now found, however, that the very large horses formerly bred in this district are much less useful than such as are of a smaller size. Mr Marshall describes in magnificent terms one of these large horses, a stallion belonging to Mr Bakewell named K (Q), which, he says, was the handsomest horse he ever saw. "He was (says he) the fancied *war-horse* of the German painters; who, in the luxuriance of imagination, never perhaps excelled the natural grandeur of this horse. A man of moderate size seemed to shrink behind his fore end, which rose so perfectly upright, his ears stood (as Mr Bakewell says every horse's ears ought to stand) perpendicularly over his fore feet. It may be said, with little latitude, that in grandeur and symmetry of form, viewed as a picturable object, he exceeded as far the horse which this superior breeder had the honour of showing to his Majesty, and which was afterwards shown publicly at London, as that horse does the meanest of the breed." A more *useful* horse, bred also by Mr Bakewell, however, is described as having "a thick carcase, his back short and straight, and his legs short and clean; as strong as an ox, yet active as a poney; equally suitable for a cart or a lighter carriage."

572 Horses belonging to Mr Bakewell described.

The stallions in this county are bred either by farmers or by persons whose business it is to *breed* them, and who therefore have the name of *breeders*. These last either cover with themselves, or let them out to others for the season, or sell them altogether to stallion-men who travel about with them to different places.—The prices given for them are from 50 to 200 guineas by purchase; from 40 to 80 or a hundred by the season; or from half a guinea to two guineas by the mare. The mares are mostly kept by the farmers, and are worked until near the times of foaling, and moderately afterwards while they suckle: the best time for foaling is supposed to be the month of March or April; and the time of weaning that of November.—"The price of foals (says Mr Marshall), for the last ten years, has been from five to ten pounds or guineas; for yearlings, 10 to 15 or 20; for two-year-olds, 15 to 25 or 30; for six year-olds, from 25 to 40 guineas."—Our author acknowledges that this breed of horses, considered abstractedly in the light in which they appear here, are evidently a profitable species of live stock, and as far as there is a market for six-years-old horses of this breed, it is profitable to agriculture. "But (says he) viewing the business of agriculture in general, not one occupier in ten can partake of the profit; and being kept in agriculture after they have reached that profitable age, they become indisputably one of its heaviest burdens. For besides a cessation of improvement of four or five guineas a-year, a decline in value of as much yearly takes place. Even the brood-mares, after they have passed that age, may, unless they be of a very superior quality, be deemed unprofitable to the farmer."

573 Prices of stallions.

574 Mr Marshall's observations on breeding horses.

Our author complains that the ancient breed of Norfolk horses is almost entirely worn out. They were small, brown-muzzled, and light boned; but they could endure very heavy work with little food; two of them were found quite equal to the plough in the soil of that county, which is not deep. The present breed is produced by a cross with the large one of Lincolnshire and Leicestershire already mentioned. He approves of the Suffolk breed, which (he says) are a "half-horse half-hog race of animals, but better adapted to the Norfolk husbandry than the Leicestershire breed: their principal fault, in his opinion, is a flatness of the rib.—In the Vale of Gloucester most farmers rear their own plough-horses, breeding of horses not being practised. They are of a very useful kind, the colour mostly black, inclinable to tan colour, short and thick in the barrel, and low on their legs. The price of a six-year-old horse from 25l. to 35l. Some cart-horses are bred in Cotswold hills; the mares are worked till the time of foaling, but not while they suckle; and the foals are weaned early, while there is plenty of grain upon the ground.

575 Norfolk breed described.

576 Suffolk and Gloucester breeds.

Yorkshire, which has been long celebrated for its breed of horses, still stands foremost in that respect among the English counties. It is principally remarkable for the breed of saddle-horses, which cannot be reared in Norfolk, though many attempts have been made for that purpose. Yorkshire stallions are frequently sent into Norfolk; but though the foals may be handsome when young, they lose their beauty when old. In Yorkshire, on the other hand, though the foal be ever so unpromising, it acquires beauty, strength, and activity as it grows up. Mr Marshall supposes that from five to ten thousand horses are annually bred up between the eastern Morelands and the Humber.

577 Yorkshire horses.

"Thirty years ago (says Mr Marshall), strong saddle-horses, fit for the road only, were bred in the Vale; but now the prevailing breed is the fashionable coach-horse, or a tall, strong, and over-sized hunter; and the shows of stallions in 1787 were flat and spiritless in comparison with those of 1783." The black cart-horse, an object of Mr Marshall's peculiar aversion, is also coming into the Vale.

In the breeding of horses he complains greatly of the negligence of the Yorkshire people, the mares being almost totally neglected; though in the brute creation almost every thing depends upon the female.

Of late years a very valuable breed of horses has been reared in the upper part of Clydesdale or Lanarkshire. They are of a middle size, well shaped, and extremely active. They are not fit for a very heavy draught, but the very quick step which they possess gives them a decided preference for the use of the plough upon well cultivated lands, as they are capable of going over an immense quantity of ground in a short time

578 Lanarkshire breed of horses.

(Q) Mr Bakewell distinguishes all his horses, bulls, and rams, by the letters of the alphabet.

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time where the draught is not ſevere. The ſame qualities render them highly uſeful for the ordinary purpoſes of farm-work. They are rapidly ſpreading over all parts of the country, and have found their way into the north of England where they are greatly valued. In the ſame part of the country, a larger breed has alſo of late been encouraged, which adds very conſiderable ſtrength or power to the activity of the former kind. They are in great requeſt about Glaſgow and other manufacturing towns. Their uſual draught is a load of about 24 cwt. in addition to the cart on which the load is placed.

With regard to the general maintenance of horſes, we have already mentioned ſeveral kinds of food upon which experiments have been made with a view to determine the moſt profitable mode of keeping them. Perhaps, however, the moſt certain method of aſcertaining this matter is by obſerving the practice of thoſe counties where horſes are moſt in uſe. Mr Marſhall recommends the Norfolk management of horſes as the cheapeſt method of feeding them practiſed anywhere; which, however, he ſeems willing to aſcribe in a great meaſure to the excellency of their breed. In the winter months, when little work is to be done, their only rack-meat is barley-ſtraw; a reſerve of clover-hay being uſually made againſt the hurry of ſeed-time. A buſhel of corn in the moſt buſy ſeaſon is computed to be an ample allowance for each horſe, and in more leiſure times a much leſs quantity ſuffices. Oats, and ſometimes barley, when the latter is cheap and unſaleable, are given; but in this caſe the barley is generally malted, *i. e.* ſteeped and afterwards ſpread abroad for a few days, until it begin to vegetate, at which time it is given to the horſes, when it is ſuppoſed to be leſs heating than in its natural ſtate. Chaff is univerſally mixed with horſe-corn: the great quantities of corn grown in this county afford in general a ſufficiency of *natural* chaff; ſo that *cut chaff* is not much in uſe: the chaff, or rather the awns of barley, which in ſome places are thrown as uſeleſs to the dunghill, are here in good eſteem as provender. Oat-chaff is deſervedly conſidered as being of much inferior quality.—It may here be remarked, that this method of keeping horſes which Mr Marſhall approves of in the Norfolk farmers, is practiſed, and probably has been ſo from time immemorial, in many places of the north of Scotland; and is found abundantly ſufficient to enable them to go through the labour required. In ſummer they are in Norfolk kept out all night, generally in clover leys, and in ſummer their keep is generally clover only, a few tares excepted.

579 Norfolk management of horſes recommended.

580 This method followed in many places in Scotland.

581 Calculations of the expence of keeping horſes.

In the fourth volume of the Annals of Agriculture, Mr Young gives an account of the expence of keeping horſes; which, notwithſtanding the vaſt numbers kept in the iſland, ſeems ſtill to be very indeterminate, as the informations he received varied no leſs than from 8l. to 25l. a-year. From accounts kept on his own farm of the expence of horſes kept for no other purpoſe than that of agriculture, he ſtated them as follows:

	L.	s.	d.
1763 Six horſes coſt per horſe	10	13	0
1764 Seven do. - -	8	10	11
1765 Eight do. - -	14	6	6
1766 Six do. - -	12	18	9

Average on the whole 11l. 12s. 3d.

By accounts received from *Northmims* in Herefordſhire, the expences ſtood as follow:

	L.	s.	d.
1768 Expence per horſe -	20	7	0
1769 - -	15	8	5
1770 - -	14	14	2
1771 - - -	15	13	3
1772 - - -	18	4	0
1773 - - -	15	11	8
1774 - -	14	4	5
1775 - - -	19	0	5
1776 - -	16	14	5

Average 16l. 13s. 1d.

On theſe diſcordant accounts Mr Young obſerves, undoubtedly with juſtice, that many of the extra expences depend on the extravagance of the ſervants; while ſome of the apparent ſavings depend either on their careleſſneſs, or *ſtealing* provender to their beaſts privately, which will frequently be done. He concludes, however, as follows: "The more exactly the expence of horſes is examined into, the more advantageous will the uſe of oxen be found. Every day's experience convinces me more and more of this. If horſes kept for uſe alone, and not for ſhow, have proved thus expenſive to me, what muſt be the expence to thoſe farmers who make their fat ſleek teams an object of vanity? It is eaſier conceived than calculated.

It muſt be obſerved, however, that the above trials or accounts are of an old date; and that during the late dearth a variety of experiments were made, which ſhew that horſes may be ſucceſsfully fed, even when engaged in hard labour, with other articles than grain. With this view, different roots have been given them as ſubſtitutes; and a great ſaving has been experienced, attended with no loſs of labour or diſadvantage to the animal: ſo that the continuance and extenſion of this ſyſtem is a matter of much importance to the public. The articles that have been chiefly employed are turnips, roota baga, potatoes, carrots, &c.—Turnips have been given in a raw ſtate, withholding about one half of the uſual allowance of corn, and in moſt inſtances the animals have done their work well, and appeared in good condition. When the roota baga has been uſed, little or no grain has been neceſſary, and the other roots already mentioned have been ſucceſsfully uſed even in a raw ſtate; but when potatoes, yams, roota baga, &c. are boiled, which has ſometimes been done, it does not appear that grain is at all neceſſary. It is to be obſerved, that young horſes eat theſe roots readily and with great reliſh; and that during the winter, with them and a ſmall portion of dry food, they are kept in as good condition and ſpirit as when fed upon graſs during the ſummer. This is a matter of much importance to young animals, as it muſt contribute greatly to their growth and future ſtrength. Whereas, in a great majority of caſes, when reared without the aid of theſe roots, they are fed in winter, when ſubſtantial food is moſt neceſſary to ſupport them againſt the ſeverity of the weather, in ſuch a manner as to be barely kept alive. During the winter months their growth is thus ſtopt; they loſe the little fleſh they had acquired during the preceding ſummer, become ſtinted and hide-bound, and, when the ſpring arrives, they are in ſo miſerable a ſtate, that a conſiderable part even of the ſummer elapſes before they can

582 Uſe of roots for feeding horſes.

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can reſume their growth. In this way, four or five years are required to bring them to the ſize that others of the ſame ſpecies attain in half that time under different management.

Sect. III. *Of the Breeding and Rearing of Black Cattle.*

583 A hornleſs breed of black cattle deſirable for work.

THESE are reared for two different purpoſes, viz. work, and fattening for ſlaughter. For the former purpoſe, Mr Marſhall remarks, that it is obviouſly neceſſary to procure a breed without horns. This he thinks would be no diſadvantage, as *horn*, though formerly an article of ſome requeſt, is now of very little value. The horns are quite uſeleſs to cattle in their domeſtic ſtate, though nature has beſtowed them upon them as weapons of defence in their wild ſtate; and our author is of opinion that it would be quite practicable to produce a hornleſs breed of black cattle as well as of ſheep, which laſt has been done by attention and perſeverance; and there are now many hornleſs breeds of theſe creatures in Britain. Nay, he inſiſts, that there are already three or four breeds of hornleſs cattle in the iſland; or that there are many kinds of which numbers of individuals are hornleſs, and from theſe, by proper care and attention, a breed might be formed. The firſt ſtep is to ſelect females; and having obſerved their imperfections, to endeavour to correct them by a well choſen male.

584 Properties requiſite in black cattle.

The other properties of a perfect breed of black cattle for the purpoſes of the dairy as well as others, ought, according to Mr Marſhall, to be as follow: 1. The head ſmall and clean, to leſſen the quantity of offal. 2. The neck thin and clean, to lighten the fore-end, as well as to leſſen the collar, and make it ſit cloſe and eaſy to the animal in work. 3. The carcaſe large, the cheſt deep, and the boſom broad, with the ribs ſtanding out full from the ſpine; to give ſtrength of frame and conſtitution, and to admit of the inteſtines being lodged within the ribs. 4. The ſhoulders ſhould be light of bone, and rounded off at the lower point, that the collar may be eaſy, but broad to give ſtrength; and well covered with fleſh for the greater eaſe of draught, as well as to furniſh a deſired point in fatting cattle. 5. The back ought to be wide and level throughout; the quarters long; the thighs thin, and ſtanding narrow at the round bone; the udder large when full, but thin and looſe when empty, to hold the greater quantity of milk; with large dug-veins to fill it, and long elaſtic teats for drawing it off with greater eaſe. 6. The legs (below the knee and hock) ſtraight, and of a middle length; their bone, in general, light and clean from fleſhineſs, but with the joints and ſinews of a moderate ſize, for the purpoſes of ſtrength and activity. 7. The fleſh ought to be mellow in the ſtate of fleſhineſs, and firm in the ſtate of fatneſs. 8. The hide mellow, and of a middle thickneſs, though in our author's opinion this is a point not yet well determined.

585 Of rearing calves without milk.

As the milk of cows is always an article of great importance, it becomes an object to the huſbandman, if poſſible, to prevent the waſte of that uſeful fluid, which in the common way of rearing calves is unavoidable. A method of bringing up theſe young animals at leſs expence was at one time propoſed by the duke of Northumberland. His plan was to make ſkimmed milk anſwer the purpoſe of that which is newly drawn from the teat; and which, he ſuppoſed, might anſwer the purpoſe at one-third of the expence of new milk. The articles to be added to the ſkimmed milk are treacle and the common linſeed oil-cake ground very fine, and almoſt to an impalpable powder, the quantities of each being ſo ſmall, that to make 32 gallons would coſt only 6d. beſides the ſkimmed milk. It mixes very readily and almoſt intimately with the milk, making it more rich and mucilaginous, without giving it any diſagreeable taſte. The receipt for making it is as follows: Take one gallon of ſkimmed milk, and to about a pint of it add half an ounce of treacle, ſtirring it until it is well mixed; then take one ounce of linſeed oil-cake finely pulverized, and with the hand let it fall gradually in very ſmall quantities into the milk, ſtirring it in the mean time with a ſpoon or ladle until it be thoroughly incorporated; then let the mixture be put into the other part of the milk, and the whole be made nearly as warm as new milk when it is firſt taken from the cow, and in that ſtate it is fit for uſe. The quantity of the oil-cake powder may be increaſed from time to time as occaſion requires, and as the calf becomes inured to its flavour. On this ſubject Mr Young remarks, that in rearing calves, there are two objects of great importance. 1. To bring them up without any milk at all; and, 2. To make ſkimmed milk anſwer the purpoſe of ſuch as is newly milked or ſucked from the cow. In conſequence of premiums offered by the London Society, many attempts have been made to accompliſh theſe deſirable purpoſes; and Mr Budel of Wanborough in Surrey was rewarded for an account of his method. This was no other than to give the creatures a gruel made of ground barley and oats. Mr Young, however, who tried this method with two calves, aſſures us that both of them died, though he afterwards put them upon milk when they were found not to thrive. When in Ireland he had an opportunity of purchaſing calves at three days old from 20d. to 3s. each; by which he was induced to repeat the experiment many times over. This he did in different ways, having collected various receipts. In conſequence of theſe he tried hay-tea, bean-meal mixed with wheat-flour, barley and oats ground nearly, but not exactly, in Mr Budd's method; but the principal one was flax-ſeed boiled into a jelly, and mixed with warm water; this being recommended more than all the reſt. The reſult of all theſe trials was, that out of 30 calves only three or four were reared; theſe few were brought up with barley and oat-meal, and a very ſmall quantity of flax-ſeed jelly; one only excepted, which at the deſire of his coachman was brought up on a mixture of two-thirds of ſkimmed milk and one-third of water, with a ſmall addition of flax-jelly well diſſolved.

Annals of Agriculture, vol. i. p. 296.

586 Mr Young's experiments.

The ſecond object, viz. that of improving ſkimmed milk, according to the plan of the duke of Northumberland, ſeems to be the more practicable of the two. Mr Young informs us, that it has anſwered well with him for two ſeaſons; and two farmers to whom he communicated it gave likewiſe a favourable report.

In the third volume of the ſame work, we are informed that the Cornwall farmers uſe the following method in rearing their calves. "They are taken from

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from the cow from the fourth to the ſixth day; after which they have raw milk from ſix to ten or fourteen days. After this, they feed them with ſcalded ſkimmed milk and gruel made of ſhelled oats, from three quarts to four being given in the morning, and the ſame in the evening. The common family broth is thought to be as good, or better, than the gruel, the ſavour of the ſalt being ſuppoſed to ſtrengthen their bowels. The proportion of gruel or broth is about one-third of the milk given them. A little fine hay is ſet before them, which they ſoon begin to eat.

587 Method of rearing calves in Cornwall.

588 Mr Crook's method.

In the 5th volume of Bath Papers, we have an account by Mr Crook of a remarkably ſucceſsful experiment on rearing calves without any milk at all. This gentleman, in 1787, weaned 17 calves; in 1788, 23; and in 1789, 15. In 1787, he bought three ſacks of linſeed, value 2l. 5s. which laſted the whole three years. One quart of it was put to ſix quarts of water; which, by boiling 10 minutes, was reduced to a jelly: the calves were fed with this mixed with a ſmall quantity of tea, made by ſteeping the beſt hay in boiling water. By the uſe of this food three times a-day, he ſays that his calves throve better than thoſe of his neighbours, which were reared with milk. Theſe unnatural kinds of food, however, are in many caſes apt to produce a looſeneſs, which in the end proves fatal to the calves. In Cornwall, they remedy this ſometimes by giving acorns as an aſtringent; ſometimes by a cordial uſed for the human ſpecies, of which opium is the baſis.

589 Norfolk method, &c.

In Norfolk, the calves are reared with milk and turnips; ſometimes with oats and bran mixed among the latter. Winter calves are allowed more milk than ſummer ones; but they are univerſally allowed new milk, or even to ſuck. In the midland counties bull-calves are allowed to remain at the teat until they be ſix, nine, or twelve months old, letting them run either with their dams or with cows of leſs value bought on purpoſe. Each cow is generally allowed one male or two female calves. Thus they grow very faſt, and become ſurpriſingly vigorous. The method of the dairy-men is to let the calves ſuck for a week or a fortnight, according to their ſtrength; next they have new milk in pails for a few meals; after that, new and ſkimmed milk mixed; then ſkimmed milk alone, or porridge made with milk, water, ground oats, &c. ſometimes with oil-cake, &c. until cheeſe-making commences; after which they have whey-porridge, or ſweet whey in the field, being carefully houſed in the night until the warm weather come in.

590 Mr Bradfute's mode.

A late intelligent Scottiſh clergyman, Mr John Bradfute of Dunſyre, once or twice ſucceſsfully made trial of treacle, as a food by means of which to rear calves without the aid of any kind of milk. He uſed it diluted with common water, and ſometimes with what is called *hay-tea*, that is to ſay, water in which hay had been boiled. The whole expence of the treacle neceſſary to bring a calf the length of uſing common food was at that time (15 years ago) about 4s. 6d. The animals came forward well, and enjoyed good health; but they grew much to the bone, and did not fatten for a conſiderable time.

591 Cattle are paſtured

For feeding cattle, two modes of practice have been propoſed, and in ſome ſituations adopted; the one mode, which is the moſt ancient, and the moſt extenſively practiſed in agricultural countries, conſiſts of turning out the cattle during the whole ſeaſon that any food for them can be found on the ground, and of taking them into the houſe during the ſeverity of winter, and of feeding them with ſuch articles as can be moſt conveniently procured in the climate and ſituation, ſuch as, ſtraw or hay of different kinds, and roots.

592 or ſtall fed.

The other mode which has been adopted to ſome extent by huſbandmen in Germany, and at times alſo in our own great towns, by perſons called *cow-feeders*, who ſupply the inhabitants with milk, is called the ſyſtem of ſtall-feeding. It conſiſts of keeping the cattle continually in the houſe at every ſeaſon of the year, and of feeding them there. By many German writers upon rural economy this ſyſtem is highly approved of, as affording the means of drawing the higheſt poſſible produce from every portion of the land, and as employing a great number of hands in the uſeful occupations of huſbandry. In a communication to the Board of Agriculture from A. Thaer, M. D. phyſician of the electoral court of Hanover, the advantages of this ſyſtem are ſaid to be founded upon the following incontrovertible principles:

593 Stall-feeding in Germany.

"1. A ſpot of ground which, when paſtured upon, will yield ſufficient food for only one head, will abundantly maintain four head of cattle in the ſtable, if the vegetables be mowed at a proper time, and given to the cattle in a proper order.

"2. The ſtall-feeding yields at leaſt double the quantity of manure from the ſame number of cattle; for the beſt and moſt efficacious ſummer manure is produced in the ſtable, and carried to the fields at the moſt proper period of its fermentation, whereas, when ſpread on the meadow, and exhauſted by the air and ſun, its power is entirely waſted.

"3. The cattle uſed to ſtall-feeding will yield a much greater quantity of milk, and increaſe faſter in weight when fattening than when they go to the field.

"4. They are leſs ſubject to accidents, do not ſuffer by the heat, by flies, and inſects, are not affected by the baneful fogs which are frequent in Germany, and bring on inflammations: on the contrary, if every thing be properly managed, they remain in a conſtant ſtate of health and vigour."

It is added that a ſufficient, or rather plentiful ſupply of food for one feed of cattle daily, if kept in a ſtable, conſiſts upon an average of 130 pounds of green, or 30 pounds of dry clover, which anſwers the ſame purpoſe. Hence one head of cattle requires in 365 days, about 10,950 pounds of dry clover, or about 100 cwts. of 110 pounds each, the portion of food being according to this mode of feeding alike both in ſummer and winter. Each head of heavy fat cattle fed in the ſtable, if plenty of food be given, yields annually 16 full double-cart loads of dung. The rotation of crops that is moſt frequently uſed in Germany upon farms occupied in ſtall-feeding, appears to be the following: "One year, manured for beans, peaſe, cabbages, potatoes, turnips, linſeed, &c.; 2. Rye; 3. Barley, mixed with clover; 4. Clover, to be mowed two or three times; 5. Clover, to be mowed once, then to be broken up, ploughed three or four times, and manured; 6. Wheat; 7. Oats."—In conſequence of the large quantity of ſtable dung produced

Breeding and Feeding of Black Cattle.

duced upon farms thus occupied, every acre of land receives every three years 10 double cart loads of that best of all kinds of manure.

It is undoubtedly to be wished that a similar mode of management could be profitably introduced into this country, from the tendency which it would have to augment the number of persons occupied in rural affairs, from the importance which it would give to farms of a moderate extent, and from the benefit which must arise from making the most of every part of the soil. It has already been introduced into several places in England, and we have little doubt that the practice will gradually extend itself, in consequence of the increasing demand for butchers meat, and for all the productions of the dairy.

594 Two modes of stall-feeding.

Of stall-feeding, however, whether with a view to the maintenance or to the fattening of cattle, it must be observed, that there are two modes of proceeding. Of late years it has been found advantageous to cultivate to a great extent turnips, potatoes, and other roots, and these now constitute a large portion of the winter food of cattle. These roots are either given to the cattle in their natural raw state, or they are given after being boiled. Of these two modes of feeding, that of giving them to the cattle raw has hitherto been the most common, but it is extremely improper, as being a thriftless plan of proceeding. The same quantity of these roots, if given in a raw state, that will barely support a horse in idleness, will enable him, when boiled, to encounter the severest labour without injury to his health or spirit. There are many animals also, such as hogs, which cannot be fattened by roots unless they undergo this process. These animals can be reared to the full size upon raw potatoes, yams, carrots, roota baga, &c. and may be kept in good health for any length of time without the aid of any other food. Under that management, however, they very seldom if ever fatten, but when the roots are boiled, they immediately begin to feed, and soon become fat upon a smaller allowance than what was necessary to keep them barely alive when given in a raw state.

The same holds true in a great degree with regard to all cattle. With a view, therefore, to make the most of the various succulent roots which are now cultivated, and which will perhaps one day be accounted the most valuable productions of our soil, it is absolutely necessary that they should be given to cattle boiled.

595 Roots given to cattle should be boiled.

Many husbandmen have long been sensible of this, but it has appeared a very formidable operation to boil the greatest part of the food of perhaps 20 horses, and 100 head of black cattle. There is nothing more true, however, than that this labour when undertaken upon skilful principles, may be rendered not only easy, but so trifling, that it may be performed by a single old man, or by a woman. To accomplish this object, however, it is necessary, that the roots be boiled not over the fire in a chaldron of metal, but at a distance from it in a large wooden vat or tub by the steam of boiling water.

596 Cheap mode of boiling roots by steam.

There are two ways of boiling roots by steam. They may either be boiled in such a way as to retain their original figure, or they may be converted into soup; both modes are performed with equal ease. All that is necessary, is to erect a boiler in any outhouse: The boiler, which may be of cast iron, ought to have a close cover or lid, having a small hole for filling it with water, which can be easily closed up, and another hole in the centre of about one-fourth of the diameter of the cover. To this last hole ought to be soldered a tube of tin-plate, commonly called *white iron*, by which the steam may ascend. This tube ought to rise perpendicularly to the height of six feet, narrowing gradually to about two inches diameter. It may then bend off at right angles, to the most convenient situation for the tub or vat in which the roots are to be boiled. When it comes perpendicularly over the centre of the vat, it must be made to descend to within two or three inches of the bottom of it, being properly supported and fixed all the way.

To boil roots with this apparatus, it is only necessary to tumble them into the tub or vat into which the end of the white iron tube descends. The tub ought then to be covered negligently. The water in the boiler being heated to ebullition, its steam or vapour rises and passes along the white iron tube, and at last descends to the bottom of the wooden vessel containing the roots, and in a very trifling space of time renders them completely soft. If it is wished to convert these roots into soup, it is only necessary to throw among them a quantity of water, and to mash them down with any large ladle or other instrument. The steam continuing to descend will speedily boil the water, and agitate and mingle the whole ingredients of which the soup may be composed. In this way by various mixtures of roots, with little or no trouble, rich broths, which human beings would not dislike, may be formed for feeding a multitude of cattle, and the soup may easily be drawn off from the bottom of the vat by means of a hole to be occasionally opened or shut with a round piece of wood.

In performing the above operation, however, of forming broth or soup, before allowing the water in the vessel over the fire to give over boiling, the hole ought to be opened by which it is usually filled with water, as the liquor in the vat might otherwise, in consequence of the pressure of the atmosphere, ascend through the white iron tube and come over into the boiler. To strengthen the white iron tube, it may be proper also to cover it all over with paper pasted to it with glue, or with a mixture of pease-meal and water.

597 Rules for fattening cattle.

To fatten cattle with success, then, we apprehend that the following rules ought to be adhered to. As a man is kept thin and meagre by whatever agitates his mind, or renders him anxious, fretful, and uncomfortable, so we ought to consider that cattle, though they want foresight of the future, have nevertheless minds capable of being irritated and disturbed, which must so far waste their bodies. In attempting to fatten them, therefore, care ought to be taken to preserve the tranquillity of their minds, and as much as possible to keep them in a state of cleanness and of moderate warmth. The food they receive ought to be varied at times to increase their appetite; but above all things it ought to be made as far as possible of easy digestion, that they may receive it in larger portions, and that a greater quantity of it may incorporate with their constitution, and not be thrown off by dung, as happens when they receive coarse nourishment. It is in vain to object to this artificial mode of proceeding, that the natural food of animals is grass alone, and that their natural

Rearing and Fattening Hogs.

natural dwelling is the open air. The ſame might be ſaid with regard to the human ſpecies. In his natural, that is, in his unimproved ſtate, a ſavage may be under the neceſſity of eating raw fleſh or herbs, or of climbing into a tree for ſhelter; but although it may be poſſible for him to ſubſiſt in this way, yet we know that this is by no means the beſt mode of his exiſtence, and that his life and health are better preſerved by the ſhelter of a ſettled dwelling, and by more delicate food prepared by induſtry. In the ſame manner it is no doubt true, that cattle can exiſt upon very coarſe food, and may be even fattened by means of it; but as a greater quantity of it becomes neceſſary, the huſbandman's profit in rearing them is ſo far diminiſhed, and the value of his lands to the community is leſſened.

Sect. IV. *Of the Rearing and Fattening of Hogs.*

The practice of keeping theſe animals is ſo general, eſpecially in England, that one ſhould think the profit attending it would be abſolutely indiſputable; and this the more eſpecially, when it is conſidered how little nicety they have in their choice of food. From ſuch experiments, however, as have been made, the matter appears to be at leaſt very doubtful, unleſs in particu-

598 Mr Mure's experiments.

lar circumſtances. In the firſt volume of Annals of Agriculture, we have an experiment by Mr Mure of feeding hogs with the cluſter potato and carrots; by which it appeared, that the profit on large hogs was much greater than on ſmall ones; the latter eating almoſt as much as the former, without yielding a proportionable increaſe of fleſh. The gain was counted by weighing the large and ſmall ones alive; and it was found, that from November 10th to January 5th, they had gained in the following proportion:

	L.	s.	d.
20 large hogs, - - -	L. 1	3	6
20 ſmall, - - - -	0	7	8
2 ſtag hogs, - - -	1	17	8

On being finiſhed with peaſe, however, it appeared, that there was not any real profit at laſt; for the accounts ſtood ultimately as follow:

Dr	L.	s.	d.	Cr	L.	s.	d.
Value of hogs at putting up,	L. 44	2	0	42 hogs ſold fat at	L. 95	0	0
33 coomb peaſe, at 14s.	23	2	0				
2 ditto, 2 buſhels barley, at 14s.	1	15	0				
56 days attendance of one man, at 14d.	3	5	4				
950 buſhels of carrots, and 598 of potatoes, at 3½d. *per* buſhel, -	22	15	8				
	L. 95	0	0		L. 95	0	0

In ſome experiments by Mr Young, related in the ſame volume, he ſucceeded ſtill worſe, not being able to clear his expences. His firſt experiment was attended with a loſs of one guinea *per* hog; the ſecond with a loſs of 11s. 8d.; the third, of only 3s. In theſe three the hogs were fed with peaſe; given whole in the two firſt, but ground into meal in the laſt. The fourth experiment, in which the hog was fed with Jeruſalem artichokes, was attended with no loſs; but another, in which peaſe were again tried, was attended with a loſs of 4s. Other experiments were tried with peaſe, which turning out likewiſe unfavourable, barley was tried ground along with peaſe and beans. This was attended with a ſmall profit, counting nothing for the trouble of feeding the animals. The expences on two hogs were 14l. 13s. 10½d, the value 15l. 11s. 3½d. ſo that there was a balance in his favour of 17s. 4½d. In another experiment in which the hogs were fed with peaſe and barley ground, the beans being omitted as uſeleſs, there was a profit of 12s. 3d. upon an expence of 20l. 15s. 9d; which our author ſuppoſes would pay the attendance. In this experiment the peaſe and barley meal were mixed into a liquor like cream, and allowed to remain in that ſtate for three weeks, till it became ſour. This was attended in two other inſtances with profit, and in a third with loſs: however, Mr Young is of opinion, that the practice will ſtill be found advantageous on account of the quantity of dung raiſed; and that the farmer can thus uſe his peaſe and barley at home without carrying them to market.

It is to be obſerved, that the above experiments were not made upon the fattening of hogs in the proper manner in which that animal ought to be fed. Its food ought undoubtedly to conſiſt chiefly of roots, ſuch as yams, potatoes, &c.; but theſe roots, as already mentioned, ought always to be boiled, or made into ſoups. With this mode of proceeding, the hog, from its rapid multiplication, and quick growth, is a very profitable kind of ſtock. It ought to be remembered, however, that of this, as well as of moſt other kinds of animals, a large breed is always to be preferred; for the difference is very trifling, or rather, in general, amounts to nothing at all, between the quantity of food neceſſary to ſupport a ſmall animal, and the quantity neceſſary to ſupport a large animal of the ſame kind.

599 Deſcription of a proper hogſty.

Hogſties are of ſimple conſtruction; they require only a warm dry place for the ſwine to lie in, with a ſmall area before, and troughs to hold their food. They are generally made with ſhed-roofs, and ſeldom above 6 or 7 feet wide.

Although ſwine are generally conſidered as the filthieſt of all animals, yet there is no animal delights more in a clean comfortable place to lie down in, and none that cleanlineſs has a better effect upon with reſpect to their thriving and feeding. In order to keep them dry, a ſufficient ſlope muſt be given, not only to the inſide where they lie, but to the outſide area, with proper drains to carry off all moiſture. The inſide ſhould alſo be a little elevated, and have a ſtep up from the area at leaſt 5 or 6 inches. Hogſties ſhould have ſeveral diviſions to keep the different ſorts of ſwine ſeparate, nor ſhould a great many ever be allowed to go together; for it is thought they feed better in ſmall numbers, and of equal ſize, than when many are put together of different ſizes. Proper diviſions muſt therefore be made, ſome for ſwine when with the boar, others for brood ſwine, and for them to farrow in, for weaning the pigs, for feeding, &c.

Swine are apt to ſpill and waſte a great deal of their meat by getting their feet among it, unleſs proper precautions

Sheep.

cautions are taken to prevent them. This may be done by making a rail or covering of thin dale slope from the back part of the trough towards the fore part, leaving just room enough to admit their heads. There should also be divisions across the troughs, according to the number of swine, to prevent the strongest driving away the weakest. These divisions need not extend to the bottom of the troughs, but should rise a little higher than the top, and may be made of pieces of board about 8 or 10 inches broad.

Sties ought to be constructed that the swine may be easily fed without going in among them. In some places it is so contrived that they may be fed through openings in the back kitchen wall, without even going out of doors. This is very convenient where only a few swine are kept for family use, and makes it easy to give them the refuse of vegetables and other things from the kitchen, which, perhaps, would otherwise be thrown away. Where pigs are to be reared on an extensive scale, there ought to be what is called in England a *pigs kitchen*, that is, a proper apparatus ought to be erected adjoining to the hogsty, for boiling their food. To avoid expence, steam ought always to be used for this purpose, in the way already described.

Sect. V. *Sheep.*

600 Experiments on feeding sheep with roots.

The rearing of sheep properly belongs to the article pasturage. So far, however, as they are fed upon the products of human industry, they belong to the present subject. In the Memoirs of the Royal Society of Agriculture in Paris for the year 1788, the result is given of certain experiments upon the advantage and economy of feeding sheep in the house with roots. The experiments were made by M. Cretté de Palluel. He states that the custom of feeding sheep in a house is common in several of the French provinces, but in others is unknown: That the mode of fattening them in that situation consisted of giving them clean corn and choice hay: That in substituting roots for corn, hay was continued to be given to them, either of clover, lucern, after-math, or any other sort. The corn commonly used for fattening sheep is barley and oats. Sometimes gray pease, or the marshed bean, and rye. "Although the sheep fed upon roots (says M. Crette) did not acquire quite so great a degree of fatness as those fed upon corn; it is however true, that they all fattened, and that if their food had been varied, they would have made greater progress: I can even assert the fact of four, which were put upon change of food towards the end of the experiment, and ate much more.

"The sheep put to potatoes ate little at first, for some days, which prevented them from thriving so much as the others; but they recovered the second month what they lost the first. As for those put to turnips and beets, they fed heartily from the first moment, and continued it. They all drank much less than those fed upon corn.

"Corn might with advantage be added to the roots: When the sheep are intended to be sold, two feeds of corn given them for a fortnight, in the intervals of their meals of roots, would harden both their flesh and their tallow.

"It was not sufficient to prove the possibility of fattening sheep with different kinds of roots; it was farther necessary to ascertain the qualities which their flesh might acquire, by the use of them. Four sheep, fed upon the four regimens, were killed the same day; there was indeed some trifling difference in the texture of their flesh, but upon the whole the flavour of all was the same. Let us then conclude, that the culture of roots opens to us infinite resources, not only for fattening of sheep, but also of beasts; and we do not doubt of their being used to the greatest advantage in bringing up cattle in the countries where they are bred.

"The knowledge of these experiments must induce farmers to adopt this culture, since it is so advantageous. Roots cannot be exported; corn, on the contrary, is exported; and the grower may sell the roots instead of consuming them. One acre of roots is equal to five acres of corn. By this means he multiplies his land, and may consequently multiply his cattle and his dunghill: added to this, roots are not subject, like corn, to the inclemencies of the seasons; the produce is always more certain; these plants being of different natures, it is not likely that they should all fail; the earth is a more faithful depository of our treasures than the atmosphere; the dreadful hurricane of the 15th of this month (July) destroyed every thing but roots; they are the only product with escaped its ravages; if the hail tore their leaves, others will soon shoot; and carrots, beets, turnips, and potatoes, will be safe."

The result of the experiments alluded to is given in the following terms:

EXPERIMENT

Experiment upon Fatting Sheep, and their Increaſe from Month to Month.

Sixteen ſheep, of the ſame age, of four different breeds, were picked out of my flock, viz. four the breed of the country, four of Beauce, four of Champagne, and four of Picardy; I weighed them alive, and marked each with a number; I divided them into four lots, and fed them on four different ſorts of food, as under.

Food.	No.	Breeds.	Weights at different Periods.—1788.					Increaſe each Month.				Total incr. which each food has produced upon four Sheep.
			Jan. 20.	Feb. 20.	Mar. 20.	April 20.	May 20.	1ſt M.	2d M.	3d M.	4th M.	
Potatoes,	1	Iſle de France,	69¾ lb.	79¾ lb.	—	—	—	10 lb.	lb.	lb.	lb.	70 lb.
	2	Beauce,	70¾	82½	90¼ lb.	93 lb.	95 lb.	11¾	7¾	2¾	2	
	3	Champagne,	69¼	83	82½	84	—	13¾	loſs ½	1½	—	
	4	Picardy,	88	95	101	—	—	15	6	—	—	
								50½	13½	4¼	2	
Turnips,	5	Iſle de France,	69	86	87	—	—	17	1	—	—	67½
	6	Beauce,	71	86	—	—	—	15	—	—	—	
	7	Champagne,	68½	78½	82½	84	84½	10	4	1½	½	
	8	Picardy,	79	95½	97½	97½	—	16½	2	—	—	
								58½	7	1½	½	
Beets,	9	Iſle de France,	72	83¼	90½	94	—	11¼	7¼	3½	—	71
	10	Beauce,	70¾	80¾	86	—	—	10	5¼	—	—	
	11	Champagne,	77¼	90½	—	—	—	13¼	—	—	—	
	12	Picardy,	80	93½	98½	100½	101	13½	5	1½	½	
								48	17½	5	½	
Oats, barley, and gray peas.	13	Iſle de France,	74	91	95½	102	106	17	4½	6½	4	92½
	14	Beauce,	73½	84¼	91½	96	—	10¾	7¼	4½	—	
	15	Champagne,	71	86¼	93	—	—	15¼	6¾	—	—	
	16	Picardy,	71	87	—	—	—	16	—	—	—	
								59	18½	11	4	

"Observation. The increaſe of theſe ſheep, during the firſt month, being ſo much more conſiderable than in the following months, muſt be attributed to this cauſe, that lean cattle put up to fatten, eat greedily until they are cloyed, which only fills them, without much increaſing their fleſh; but, on the contrary, the increaſe produced in the enſuing months, although apparently leſs, turns all to profit in fleſh and tallow."

Sect. VI. *Rabbits.*

In particular ſituations theſe animals may be kept to advantage, as they multiply exceedingly, and require no trouble in bringing up. A conſiderable number of them are kept in Norfolk, where many parts, conſiſting of barren hills or heaths, are proper for their reception. They delight in the ſides of ſandy hills, which are generally unproductive when tilled; but level ground is improper for them. Mr Marſhall is of opinion, that there are few ſandy or other looſe-ſoiled hills which would not pay better in rabbit warrens than any thing elſe. "The hide of a bullock (ſays he) is not worth more than $\frac{1}{20}$th of his carcaſe; the ſkin of a ſheep may, in full wool, be worth from a ſixth to a tenth of its carcaſe; but the fur of a rabbit is worth twice the whole value of the carcaſe; therefore ſuppoſing a rabbit to conſume a quantity of food in proportion to its carcaſe, it is, on the principle offered, a ſpecies of ſtock nearly three times as valuable as either cattle or ſheep. Rabbit warrens ought to be incloſed with a ſtone or ſod wall; and at their firſt ſtocking, it will be neceſſary to form burrows to them until they have time to make them to themſelves. Boring the ground horizontally with a large auger is perhaps the beſt method that can be practiſed. Eagles, kites, and other birds of prey, as well as cats, weaſels, and pole-cats, are great enemies of rabbits. The Norfolk warreners catch the birds by traps placed on the tops of ſtumps of trees or artificial hillocks of a conical form, on which they naturally alight.—Traps alſo ſeem to be the only method of getting rid of the other enemies; though thus the rabbits themſelves are in danger of being caught.

601 Rabbits more valuable than black cattle or ſheep.

602 Method of deſtroying birds of prey.

Rabbits may be fed during the ſummer with clover and

Poultry.

and other green food, and during the winter with cabbages. Where they are kept in an inclofure as part of the ftock of the farm, a practice which has not yet been ufed in this country, they ought to be fed with great regularity, and with as much as they are willing to take. When this is done they thrive upon a very moderate quantity of food; but if they are once allowed to fuffer hunger in any great degree, they become extremely ravenous, and for a long time can fcarcely be fatisfied with food. In a communication to the Board of Agriculture from M. Bertrand of
603 Mechlin, in the Netherlands, we are informed that the rabbits of the Angora breed yield in Normandy an uncommonly valuable wool, which ferves as a primary material in feveral confiderable manufactures. The Normans affert, that each rabbit yields wool of the value of a crown or fix livres. M. Bertrand having difcovered that thefe rabbits are extremely fond of the leaves of the *robinia pfeudo acacia*, (the falfe acacia), made the following trial of its effects. He fed fome females with thefe leaves only, while to others he gave cabbage leaves and the common food furnifhed to thefe animals. He obferved that the young ones proceeding from the females fed on the leaves of the *robinia*, grew larger and in lefs time, and that their coats and wool were finer than on the others fed in the common way. He caufed the fkins of the indigenous rabbits fed with the robinia leaves to be examined by hatters, and they valued them much more than the common ones, afferting that their wool approached in quality to that of hares. The robinia, he obferves, thrives on barren heaths. Its branches and leaves are remarkably numerous. Its leaves may be converted into hay, which rabbits and other animals devour eagerly. One perfon is able to cut a fufficient quantity of branches for a great number of rabbits; and turnips, vetches, beans, and other vegetables, can be fown under the trees.

Angora breed of rabbits.

SECT. VII. *Poultry*.

604 Poultry ought to be confined.

POULTRY, if rightly managed, might be a fource of great profit to the farmer, but where many are kept, they ought not to be allowed to go at large, in which cafe little profit can be expected from them, for not only will many of their eggs be loft, and many of themfelves perhaps deftroyed by vermin, but at certain feafons they do a great deal of mifchief both in the barn-yard and in the field. No doubt they pick up fome grain at the barn doors that might otherwife be loft, but if the ftraw is properly threfhed and fhaken, there would be very little of this. In the common carelefs way of threfhing a great deal of corn is undoubtedly thrown out among the ftraw; but when we confider the dung of the fowls and their feathers that get among it, and the injury thefe muft do to the cattle, this is no object. It is much better to allow the poultry a certain quantity of food, and to let the cattle have the benefit of what corn may remain among the ftraw.

Poultry ought therefore always to be confined, but not in a clofe, dark, diminutive hovel, as is often the cafe; they fhould have a fpacious airy place properly conftructed for them. Some people are of opinion that each fort of poultry fhould be kept by itfelf. This, however, is not abfolutely neceffary; for all forts may be kept promifcuoufly together, provided they have a place fufficiently large to accommodate them conveniently, and proper divifions and nefts for each kind to retire to feparately, which they will naturally do of themfelves.

This method is practifed with great fuccefs at Mr Wakefield's, near Liverpool, who keeps a large ftock of turkeys, geefe, hens, and ducks, all in the fame place; and although young turkeys are in general confidered fo difficult to bring up, he rears great numbers of them in this manner every feafon with little or no trouble whatever. He has about three quarters or near a whole acre inclofed with a fence only fix or feven feet high, formed of flabs fet on end, or any thinnings of fir or other trees fplit and put clofe together. They are faftened by a nail near the top and another near the bottom, and are pointed fharp, which I fuppofe prevents the poultry flying over, for they never attempt it although fo low. Within this fence are places done up flightly (but well fecured from wet) for each fort of poultry; alfo a pond or ftream of water running through it. Thefe poultry are fed almoft entirely with potatoes boiled in fteam, and thrive aftonifhingly well. The quantity of dung that is made in this poultry-place is alfo an object worth attention; and when it is cleared out, a thin paring of the furface is at the fame time taken off, which makes a valuable compoft.

Communication to the Board of Agriculture, by Robert Beatfon, Efq.

605 Example of a proper mode of keeping poultry.

It is generally underftood that a full-grown hen continues in her prime for three years, and that during that period, if properly fed, fhe will lay at a medium 200 eggs every year. The number, however, of eggs may be greatly increafed by making the place to which this kind of poultry retire at night very warm and comfortable by its being placed contiguous to a wall, on the other fide of which a fire is kept, or by its being heated in any other manner. In the cottages of the poor in Scotland, where the poultry and the inhabitants fleep under the fame roof, the hens continue with a moderate portion of food to produce eggs during the greateft part of the winter.

606 Great number of turkeys reared in Norfolk.

In Norfolk a great number of turkeys are bred, of a fize and quality fuperior to thofe in other parts. Mr Marfhall accounts for their number in the following manner: "It is underftood in general, that to rear turkeys with fuccefs, it is neceffary that a male bird fhould be kept upon the fpot to impregnate the eggs fingly; but the good houfewives of this country know, that a daily intercourfe is unneceffary; and that if the hen be fent to a neighbouring cock previous to the feafon of exclufion, one act of impregnation is fufficient for one brood. Thus relieved from the expence and difagreeablenefs of keeping a male bird, moft little farmers, and many cottagers, rear turkeys. This accounts for their number; and the fpecies and the food they are fatted with (which, I believe, is wholly buck) account for their fuperior fize and quality."

The following account of the Lincolnfhire management of geefe is given by Mr John Foote of Brandon, in the Annals of Agriculture. "It is generally Vol. xiv.
allowed, that three geefe to one gander is fufficient; 607
more geefe would be too many, fo as to render the eggs abortive. The quantity of eggs to every goofe for fitting about 12 or 13. They muft be fed with corn

Lincolnfhire management of geefe.

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corn in their water whilst sitting, near them, so as to feed at pleasure. The ganders should be allowed to keep near them, so that they can see them, as they will naturally watch as a guard over their own geese.

"Their nests should be made for them of straw, and confined so as the eggs cannot roll out when the geese turn them, which they do every day.

"When near hatching, the shell should be broke a little against the beak or bill of the gosling, to give air, or to enable it to receive strength to throw off the shell at a proper time. The method of plucking them about the beginning of April is this: Pluck gently and carefully the fine feathers off their breast and back; but be careful not to pull or interrupt their down nor pen feathers.

"You also pull their quills, five out of a wing; but I think four would be better. The quills will bear pulling in 13 or 14 weeks again, twice in a year; the feathers three times a year, of the old geese and ganders, seven weeks from the first pulling; and then again seven weeks after, which is the last pulling of the year.

"The young geese may be pulled once at 13 or 14 weeks old, but not quilled, being hatched in March.

"If the geese are late in hatching, I expect the brood geese should not be plucked so soon as April, but the month after.

"If they are fed with barley and oats, as they ought to be, they will thrive and do the better, and their feathers will grow the faster, and be better in quality; they must have plenty of grass and water.

"Although persons not acquainted with the management of geese, as above described, may think it inhuman; yet I am credibly informed, they will do better than where they do not pluck them, if they are properly done, as they lose their feathers by moulting, and would not be so healthy.

"It is proved, that by annually plucking geese, as in Lincolnshire, there is saved, by the increase of feathers, many hundred pounds value, which other countries waste, though a mistaken opinion, as not an object worth their attention. Goose feathers are now sold at 18s. a stone, that used about 25 years ago to be bought at 10s. or 11s. in that county.

"A goose will produce by this method about 1s. 6d. annually of good feathers and quills."

Sect. VIII. *Of the Management of the Dairy.*

608 Importance of the dairy.

In all but the richest corn countries, this is a most important branch of the business of a husbandman. It includes not only the proper method of preserving milk in a wholesome and uncorrupted state, but also the manufacturing from it the two valuable articles of butter and cheese. We shall first consider the subject of the dairy in a general manner; after which, we shall take notice of the mode of preparing butter and cheese.

609 Principles on which a dairy ought to be managed.

Dr James Anderson remarks, that when a dairy is established, the undertaker may sometimes think it his interest to obtain the greatest possible quantity of produce; sometimes it may be more beneficial for him to have it of the finest quality; and at other times it may be necessary to have both these objects in view, the one or the other in a greater or less proportion: it is therefore of importance that he should know how he may accomplish the one or the other of these purposes in the easiest and most direct manner.

To be able to convert his milk to the highest possible profit in every case, he ought to be fully acquainted with every circumstance respecting the manufacture both of butter and of cheese; as it may in some cases happen, that a certain portion of that milk may be more advantageously converted into butter than into cheese, while another portion of it would return more profit if made into cheese.

The first thing to be adverted to, in an undertaking of this nature, is to choose cows of a proper sort. Among this class of animals, it is found by experience, that some kinds give milk of a much thicker consistence, and richer quality, than others; nor is this richness of quality necessarily connected with the smallness of the quantity yielded by cows of nearly an equal size; it therefore behoves the owner of a dairy to be peculiarly attentive to this circumstance. In judging of the value of a cow, it ought rather to be the quantity and the quality of the cream produced from the milk of the cow, in a given time, than the quantity of the milk itself: this is a circumstance that will be shewn hereafter to be of more importance than is generally imagined. The small cows of the Alderney breed afford the richest milk hitherto known; but individual cows in every country may be found, by a careful selection, that afford much thicker milk than others; these therefore ought to be searched for with care, and their breed reared with attention, as being peculiarly valuable.

Few persons, who have had any experience at all in the dairy, can be ignorant, however, that in comparing the milk of two cows, to judge of their respective qualities, particular attention must be paid to the time that has elapsed since their calving; for the milk of the same cow is always thinner soon after calving than it is afterwards; as it gradually becomes thicker, though generally less in quantity, in proportion to the time since the cow has calved. The colour of the milk, soon after calving, is richer than it is afterwards; but this, especially for the first two weeks, is a faulty colour, that ought not to be coveted.

To make the cows give abundance of milk, and of a good quality, they must at all times have plenty of food. Grass is the best food yet known for this purpose, and that kind of grass which springs up spontaneously on rich dry soils is the best of all. If the temperature of the climate be such as to permit the cows to graze at ease throughout the day, they should be suffered to range on such pastures at freedom; but if the cows are so much incommoded by the heat as to be prevented from eating through the day, they ought in that case to be taken into cool shades for protection; where, after allowing them a proper time to ruminate, they should be supplied with abundance of green food, fresh-cut for the purpose, and given to them by hand frequently, in small quantities, fresh and fresh, so as to induce them to eat it with pleasure. When the heat of the day is over, and they can remain abroad with ease, they may be again turned into the pasture, where they should be allowed to range with freedom all night, during the mild weather of summer.

Cows, if abundantly fed, should be milked three times a day during the whole of the summer season; in the morning early, at noon, and in the evening, just before night-fall.

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night-fall. In the choice of perſons for milking the cows, great caution ſhould be employed; for if that operation be not carefully and properly performed, not only the quantity of the produce of the dairy will be greatly diminiſhed, but its quality alſo will be very much debaſed; for if all the milk be not thoroughly drawn from a cow when ſhe is milked, that portion of milk which is left in the udder ſeems to be gradually abſorbed into the ſyſtem, and nature generates no more than to ſupply the waſte of what has been taken away. If this leſſened quantity be not again thoroughly drawn off, it occaſions a yet farther diminution of the quantity of milk generated; and thus it may be made to proceed, in perpetual progreſſion from little to leſs, till none at all is produced. In ſhort, this is the practice in all caſes followed, when it is meant to allow a cow's milk to dry up entirely, without doing her hurt. In this manner, therefore, the profits of a dairy might be wonderfully diminiſhed; ſo that it much behoves the owner of it to be extremely attentive to this circumſtance, if he wiſhes to avoid ruin. It ought to be a rule without an exception, never to allow this important department to be entruſted, without controul, to the management of hired ſervants. Its importance will be ſtill more manifeſt from the following aphoriſms.

Aphoriſm 1. "Of the milk that is drawn from any cow at one time, that which comes off at the firſt is always thinner, and of a much worſe quality, than that which comes afterwards; and the richneſs goes on continually increaſing to the very laſt drop that can be drawn from the udder at that time."

Few perſons are ignorant that the milk which is laſt of all taken from the cow at milking (in this country called *ſtroakings*) is richer than the reſt of the milk; but fewer ſtill are aware of the greatneſs of the diſproportion between the quality of the firſt and the laſt drawn milk, from the ſame cow, at one milking. The following facts (ſays our author) reſpecting this circumſtance were aſcertained by me many years ago, and have been confirmed by many ſubſequent experiments and obſervations.

Having taken ſeveral large tea-cups, exactly of the ſame ſize and ſhape, one of theſe tea-cups was filled at the beginning of the milking, and the others at regular intervals, till the laſt, which was filled with the dregs of the ſtroakings. Theſe cups were then weighed, the weight of each having been ſettled, ſo as to aſcertain that the quantity of milk in each was preciſely the ſame; and from a great number of experiments, frequently repeated with many different cows, the reſult was in all caſes as follows:

Firſt, The quantity of cream obtained from the firſt-drawn cup was, in every caſe, much ſmaller than from that which was laſt drawn; and thoſe between afforded leſs or more as they were nearer the beginning or the end. It is unneceſſary here to ſpecify theſe intermediate proportions; but it is proper the reader ſhould be informed, that the quantity of cream obtained from the laſt-drawn cup, from ſome cows, exceeded that from the firſt in the proportion of ſixteen to one. In other cows, however, and in particular circumſtances, the diſproportion was not quite ſo great; but in no caſe did it fall ſhort of the rate of eight to one. Probably, upon an average of a great many cows, it might be found to run as ten or twelve to one.

Secondly, The difference in the quality of the cream, however, obtained from theſe two cups, was much greater than the difference in the quantity. In the firſt cup, the cream was a thin tough film, thinner, and perhaps whiter, than writing paper; in the laſt, the cream was of a thick *butyrous* conſiſtence, and of a glowing richneſs of colour that no other kind of cream is ever found to poſſeſs.

Thirdly, The difference in the quality of the milk that remained, after the cream was ſeparated, was perhaps ſtill greater than either in reſpect to the quantity or the quality of the cream. The milk in the firſt cup was a thin bluiſh liquid, as if a very large proportion of water had been mixed with ordinary milk; that in the laſt cup was of a thick conſiſtence, and yellow colour, more reſembling cream than milk both in taſte and appearance.

From this important experiment, it appears that the perſon who, by bad milking of his cows, loſes but half a pint of his milk, loſes in fact about as much cream as would be afforded by ſix or eight pints at the beginning, and loſes, beſides, that part of the cream which alone can give richneſs and high flavour to his butter.

Aphoriſm 2. "If milk be put into a diſh, and allowed to ſtand till it throws up cream, that portion of cream which riſes firſt to the ſurface is richer in quality, and greater in quantity, than what riſes in a ſecond equal ſpace of time; and the cream that riſes in the ſecond interval of time is greater in quantity, and richer in quality, than that which riſes in a third equal ſpace of time; that of the third than the fourth, and ſo on: the cream that riſes decreaſing in quantity, and declining in quality, continually, as long as any riſes to the ſurface."

Our ingenious author confeſſes, that his experiments not having been made with ſo much accuracy in this caſe as in the former, he was not enabled to aſcertain the difference in the proportion that takes place in equal portions of time; but they have been ſo often repeated as not to leave any room to doubt the fact, and it will be allowed to be a fact of no ſmall importance in the management of the dairy. It is not certain, however, but that a greater quantity of cream may, upon the whole, be obtained from the milk by taking it away at different times: but the proceſs is ſo troubleſome as not to be counterbalanced by the increaſed quantity obtained, if indeed an increaſed quantity be thus obtained, which is not as yet quite certain.

Aphoriſm 3. "Thick milk always throws up a ſmaller proportion of the cream it actually contains, to the ſurface, than milk that is thinner; but that cream is of a richer quality. If water be added to that thick milk, it will afford a conſiderably greater quantity of cream than it would have done if allowed to remain pure, but its quality is, at the ſame time, greatly debaſed."

This is a fact that every perſon attentive to a dairy muſt have remarked; but I have never (ſays our author) heard of any experiment that could aſcertain, either the preciſe amount of the increaſed quantity of cream that might thus be obtained, or of the ratio in the decreaſe of its quality. The effects of mixing water with the milk in a dairy are at leaſt aſcertained; and the knowledge of the fact will enable attentive perſons to follow that practice which they think will beſt promote their own intereſt.

Aphoriſm 4. "Milk which is put into a bucket or other

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other proper veſſel, and carried in it to any conſiderable diſtance, ſo as to be much agitated, and in part cooled, before it be put into the milk-pans to ſettle for cream, never throws up ſo much, nor ſo rich cream, as if the ſame milk had been put into the milk-pans directly after it was milked."

In this caſe, it is believed the loſs of cream will be nearly in proportion to the time that has elapſed, and the agitation the milk has ſuſtained, after being drawn from the cow. But Dr Anderſon ſays that he is not yet in poſſeſſion of any experiments which ſufficiently aſcertain how much is to be aſcribed to the time, and the agitation, taken ſeparately. On every branch of agriculture we find experiments wanting, at each ſtep we advance in our inquiries; and it is the duty of every inquirer to point out, as he goes along, where they are wanted, ſince the labours of no one man can poſſibly complete the whole.

From the above facts, the following corollaries ſeem to be clearly deducible:

Firſt, It is of importance that the cows ſhould be always milked as near the dairy as poſſible, to prevent the neceſſity of carrying and cooling the milk before it is put into the diſhes; and as cows are much hurt by far driving, it muſt be a great advantage in a dairy-farm to have the principal graſs fields as near the dairy or homeſtead as poſſible.

Secondly, The practice of putting the milk of all the cows of a large dairy into one veſſel, as it is milked, there to remain till the whole milking is finiſhed, before any part of it is put into the milk-pans—ſeems to be highly injudicious; not only on account of the loſs that is ſuſtained by agitation and cooling, but alſo, more eſpecially, becauſe it prevents the owner of the dairy from diſtinguiſhing the good from the bad cow's milk ſo as to ſeparate theſe from each other, where it is neceſſary. He may thus have the whole of his dairy product greatly debaſed by the milk of one bad cow, for years together, without being able to diſcover it. A better practice, therefore, would be, to have the milk drawn from each cow put ſeparately into the creaming-pans as ſoon as it is milked, without being ever mixed with any other. Thus would the careful manager of the dairy be able on all occaſions to obſerve the particular quality of each individual cow's milk, as well as its quantity, and to know with preciſion which of his cows it was his intereſt to diſpoſe of, and which of them he ought to keep and breed from.

Thirdly, If it be intended to make butter of a very fine quality, it will be adviſable in all caſes to keep the milk that is firſt drawn ſeparate from that which comes laſt; as it is obvious, that if this be not done, the quality of the butter will be greatly debaſed, without much augmenting its quantity. It is alſo obvious, that if this is done, the quality of the butter will be improved in proportion to the ſmallneſs of the quantity of the laſt-drawn milk that is retained; ſo that thoſe who wiſh to be ſingularly nice in this reſpect, will do well to retain only a very ſmall portion of the laſt drawn milk.

To thoſe owners of dairies who have profit only in view, it muſt ever be a matter of trial and calculation, how far it is expedient for them to carry the improving of the quality of their butter at the expence of diminiſhing its quantity. In different ſituations prudence will point out different kinds of practice as moſt eligible; and all perſons muſt be left, after making accurate trials, to determine for themſelves. It is likewiſe a conſideration of no ſmall importance, to determine in what way the inferior milk, that is thus to be ſet apart where fine butter is wanted, can be employed with the greateſt profit. In the Highlands of Scotland they have adopted, without thinking of the improvement of their butter, a very ſimple and economical practice in this reſpect. As the rearing of calves is there a principal object with the farmer, every cow is allowed to ſuckle her own calf with a part of her milk, the remainder only being employed in the dairy. To give the calf its portion regularly, it is ſeparated from the cow, and kept in an incloſure, with all the other calves belonging to the ſame farm. At regular times, the cows are driven to the door of the incloſure, where the young calves fail not to meet them. Each calf is then ſeparately let out, and runs directly to its mother, where it ſucks till the dairy-maid judges it has had enough; ſhe then orders it to be driven away, having previouſly ſhackled the hinder legs of the mother, by a very ſimple contrivance, to oblige her to ſtand ſtill. Boys drive away the calf with ſwitches, and return it to the incloſure, while the dairy-maid milks off what was left by the calf: thus they proceed till the whole of the cows are milked. They obtain only a ſmall quantity of milk, it is true, but that milk is of an exceeding rich quality; which, in the hands of ſuch of the inhabitants as know how to manage it, is manufactured into the richeſt marrowy butter that can be anywhere met with. This richneſs of the Highland butter is univerſally aſcribed to the old graſs the cows feed upon in their remote glens; but it is in fact chiefly to be attributed to the practice here deſcribed, which has long prevailed in thoſe regions. Whether a ſimilar practice could be economically adopted elſewhere, our author takes not upon him to ſay; but doubtleſs other ſecondary uſes might be found for the milk of inferior quality. On ſome occaſions, it might be converted into butter of an inferior quality; on other occaſions, it might be ſold ſweet, where the ſituation of the farm was within reach of a market-town; and on others, it might be converted into cheeſes, which, by being made of ſweet milk, would be of a very fine quality if carefully made. Still other uſes might be deviſed for its application; of which the following is worthy of notice. Take common ſkimmed milk, when it has begun to turn ſour, put it into an upright ſtand-churn, or a barrel with one of its ends out, or any other convenient veſſel. Heat ſome water, and pour it into a tub that is large enough to contain with eaſe the veſſel in which the milk was put. Set the veſſel containing the milk into the hot water, and let it remain there for the ſpace of one night. In the morning it will be found that the milk has ſeparated into two parts; a thick cream-like ſubſtance, which occupies the upper part of the veſſel, and a thin watery part, that remains at the bottom. Draw off the thin part (called in Scotland *wigg*) by opening a ſtop-cock, placed for that purpoſe cloſe above the bottom, and reſerve the cream for uſe. Not much leſs than half of the milk is thus converted into a ſort of cream, which, when well made, ſeems to be as rich and fat as real cream itſelf, and is only diſtinguiſhable from it by its ſourneſs. It is eaten with ſugar, and eſteemed a great delicacy, and uſually ſells at double the price of

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of fresh unskimmed milk. It requires practice, however to be able to make this nicely; the degree of the heat of the water, and many other circumstances, greatly affecting the operation.

Fourthly, If the quality of the butter be the chief object attended to, it will be necessary, not only to separate the first from the last drawn milk, but also to take nothing but the cream that is first separated from the best milk, as it is this first rising cream alone that is of the prime quality. The remainder of the milk, which will be still sweet, may be either employed for the purpose of making sweet-milk cheeses, or may be allowed to stand, to throw up cream for making butter of an inferior quality, as circumstances may direct.

Fifthly, From the above facts, we are enabled to perceive, that butter of the very best possible quality can only be obtained from a dairy of considerable extent, judiciously managed; for when only a small portion of each cow's milk can be set apart for throwing up cream, and when only a small proportion of that cream can be reserved, of the prime quality, it follows (the quantity of milk being upon the whole very inconsiderable), that the quantity of prime cream produced would be so small as to be scarcely worth manufacturing separately.

Sixthly, From these premises we are also led to draw another conclusion, extremely different from the opinion that is commonly entertained on this subject, viz. That it seems probable, that the very best butter could be made with economy in those dairies only where the manufacture of cheese is the principal object. The reasons are obvious: If only a small portion of milk should be set apart for butter, all the rest may be made into cheese, while it is yet warm from the cow, and perfectly sweet; and if only that portion of cream which rises during the first three or four hours after milking is to be reserved for butter, the rich milk which is left after that cream is separated, being still perfectly sweet, may be converted into cheese with as great advantage nearly as the newly-milked milk itself.

But as it is not probable that many persons could be found who would be willing to purchase the very finest butter, made in the manner above pointed out, at a price that would be sufficient to indemnify the farmer for his trouble in making it, these hints are thrown out merely to shew the curious in what way butter possessing this superior degree of excellence may be obtained, if they choose to be at the expence; but for an ordinary market, Dr Anderson is satisfied, from experience and attentive observation, that if in general about the first drawn half of the milk be separated at each milking, and the remainder only set up for producing cream, and if that milk be allowed to stand to throw up the whole of its cream (even till it begins sensibly to taste sourish), and that cream be afterwards carefully managed, the butter thus obtained will be of a quality greatly superior to what can usually be procured at market, and its quality not considerably less than if the whole of the milk had been treated alike. This, therefore, is the practice that he thinks most likely to suit the frugal farmer, as his butter, though of a superior quality, could be afforded at a price that would always ensure it a rapid sale.

610 Dairy defined.

Our author now proceeds to enumerate the properties of a dairy. The milk-house ought to be cool in summer and warm in winter; so that an equal temperature may be preserved throughout the year. It ought also to be dry, so as to admit of being kept sweet and clean at all times. A separate building should be erected for the purpose, near a cool spring or running water, where the cows may have easy access to it, and where it is not liable to be incommoded by stagnant water. The apartment where the milk stands should be well thatched, have thick walls, and a ventilator in the top for admitting a free circulation of air. There should also be an apartment with a fire-place and caldron, for the purpose of scalding and cleaning the vessels. The Doctor is of opinion, that the temperature of from 50 to 55 degrees is the most proper for separating the cream from the milk, and by proper means this might easily be kept up, or nearly so, both summer and winter.

611 Wooden utensils preferable to every other kind.

The utensils of the dairy should be all made of wood, in preference either to lead, copper, or even cast iron. These metals are all very easily soluble in acids; the solutions of the two first highly poisonous; and though the latter is innocent, the taste of it might render the products highly disagreeable.

612 History of butter.

Butter, though used at present as food in most countries of Europe, was not known, or known very imperfectly, to the ancients. This, we think, is completely proved by Professor Beckmann in the second volume of his *History of Inventions*. In our translation of the Hebrew Scripture, there is indeed frequent mention made of butter at very early periods; but, as the Professor well observes, the greatest masters of biblical criticism unanimously agree, that the word so translated signifies milk or cream, or sour thick milk, and cannot possibly mean what we call *butter*. The word plainly alludes to something liquid, which was used for washing the feet, which was drunk, and which had sometimes the power of intoxicating; and we know that mares milk may be so prepared as to produce the same effect. See Koumiss.

The oldest mention of butter, the Professor thinks, is in the account of the Scythians given by Herodotus (lib. iv. 2.), who says, that "these people pour the milk of their mares into wooden vessels, cause it to be violently stirred or shaken by their blind slaves, and separate the part which arises to the surface, as they consider it as more valuable and delicious than what is collected below it." That this substance must have been a soft kind of butter, is well known; and Hippocrates gives a similar account of Scythian butter, and calls it πικεριον, which Galen translates by the word βουτυρον. The poet Anaxandrides, who lived soon after Hippocrates, describing the marriage-feast of Iphicrates, who married the daughter of Cotys king of Thrace, says, that the Thracians ate butter, which the Greeks at that time considered as a wonderful kind of food.

Dioscorides says, that good butter was prepared from the fattest milk, such as that of sheep or goats, by shaking it in a vessel till the fat was separated. To this butter he ascribes the same effects, when used externally, as those produced by our butter at present. He adds also, and he is the first writer who makes the observation, that fresh butter might be melted and poured over pulse and vegetables instead of oil, and that it might be employed in pastry in the room of other fat substances.

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Galen, who distinguishes and confirms in a more accurate manner the healing virtues of butter, expressly remarks, that cows milk produces the fattest butter; that butter made from sheep's or goats milk is less rich; and that asses milk yields the poorest. He expresses his astonishment, therefore, that Dioscorides should say that butter was made only from the milk of sheep and goats. He assures us that he had seen it made from cows milk, and that he believes it had thence acquired its name. "Butter (says he) may be very properly employed for ointments; and when leather is besmeared with it, the same purpose is answered as when it is rubbed over with oil. In cold countries, which do not produce oil, butter is used in the baths; and that it is a real fat, may be readily perceived by its catching fire when poured over burning coals." What has been here said is sufficient to shew that butter must have been very little known to or used by the Greeks and the Romans in the time of Galen, that is, at the end of the second century.

The professor having collected, in chronological order, every thing which he could find in the works of the ancients respecting butter, concludes, that it is not a Grecian, and much less a Roman invention, but that the Greeks were made acquainted with it by the Scythians, the Thracians, and the Phrygians, and the Romans by the people of Germany. He is likewise decidedly of opinion, that when these two polished nations had learned the art of making it, they used it not as food, but only as an ointment, or sometimes as a medicine. "We never find it (says he) mentioned by Galen and others as a food, though they have spoken of it as applicable to other purposes. No notice is taken of it by Apicius; nor is there any thing said of it in that respect by the authors who treat on agriculture, though they have given us very particular information concerning milk, cheese, and oil."

The ancient Christians of Egypt burnt butter in their lamps instead of oil; and in the Roman churches, it was anciently allowed, during Christmas time, to burn butter instead of oil, on account of the great consumption of it otherwise.

613 Qualities of butter.

Butter is the fat, oily, and inflammable part of the milk. This kind of oil is naturally distributed through all the substance of the milk in very small particles, which are interposed betwixt the caseous and serous parts, amongst which it is suspended by a slight adhesion, but without being dissolved. It is in the same state in which oil is in emulsions: hence the same whiteness of milk and emulsions; and hence, by rest, the oily parts separate from both these liquors to the surface, and form a cream. See EMULSION.

When butter is in the state of cream, its proper oily parts are not yet sufficiently united together to form a homogeneous mass. They are still half separated by the interposition of a pretty large quantity of serous and caseous particles. The butter is completely formed by pressing out these heterogeneous parts by means of continued percussion. It then becomes an uniform soft mass.

Fresh butter, which has undergone no change, has scarcely any smell; its taste is mild and agreeable, it melts with a weak heat, and none of its principles are disengaged by the heat of boiling water. These properties prove, that the oily part of butter is of the nature of the fat, fixed, and mild oils obtained from many vegetable substances by expression. See OILS.—The half fluid consistence of butter, as of most other concrete oily matters, is thought to be owing to a considerable quantity of acid united with the oily part; which acid is so well combined, that it is not perceptible while the butter is fresh, and has undergone no change; but when it grows old, and undergoes some kind of fermentation, then the acid is disengaged more and more; and this is the cause that butter, like oils of the same kind, becomes rancid by age.

Butter is constantly used in food, from its agreeable taste; but to be wholesome, it must be very fresh and free from rancidity, and also not fried or burnt; otherwise its acrid and even caustic acid, being disengaged, disorders digestion, renders it difficult and painful, excites acrid empyreumatic belchings, and introduces much acrimony into the blood. Some persons have stomachs so delicate, that they are even affected with these inconveniences by fresh butter and milk. This observation is also applicable to oil, fat, chocolate, and in general to all oleaginous matters.

614 Rules for making butter.

Dr James Anderson, whom we have already quoted, gives the following minute directions for making and preserving butter. The creaming dishes, when properly cleaned, sweet, and cool, ought to be filled with the milk as soon as it is drawn from the cow, having been first carefully strained through a cloth, or close strainer made of hair or wire: the doctor prefers silver wire to every other. The creaming dishes ought never to exceed three inches in depth; but they may be so broad as to contain a gallon and a half; when filled they ought to be put on the shelves of the milk-house, and remain there until the cream be fully separated. If the finest butter be intended, the milk ought not to stand above six or eight hours, but for ordinary butter it may stand 12 hours or more; yet if the dairy be very large, a sufficient quantity of cream will be separated in two, three, or four hours, for making the best butter. It is then to be taken off as nicely as possible by a skimming dish, without lifting any of the milk; and immediately after put into a vessel by itself, until a proper quantity for churning be collected. A firm, neat, wooden barrel seems well adapted for this purpose, open at one end, and having a lid fitted to close it. A cock or spigot ought to be fixed near the bottom, to draw off any thin or serous part which may drain from the cream; the inside of the opening should be covered with a bit of fine silver wire gauze, in order to keep back the cream while the serum is allowed to pass; and the barrel should be inclined a little on its stand, to allow the whole to run off.

615 Cream ought to be kept some time before it be made into butter.

The doctor contradicts the opinion that very fine butter cannot be obtained, except from cream that is not above a day old. On the contrary, he insists that it is only in very few cases that even tolerably good butter can be obtained from cream that is not above one day old. The separation of butter from cream only

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only takes place after the cream has attained a certain degree of acidity. If it be agitated before that acidity has begun to take place, no butter can be obtained, and the agitation muſt be continued till the time that the ſourneſs is produced; after which the butter begins to form. "In ſummer, while the climature is warm, the heating may be, without very much difficulty, continued until the acidity be produced, ſo that butter may be got: but in this caſe the proceſs is long and tedious; and the butter is for the moſt part of a ſoft conſiſtence, and tough and gluey to the touch. If this proceſs be attempted during the cold weather in winter, butter can ſcarcely be in any way obtained, unleſs by the application of ſome great degree of heat, which ſometimes aſſiſts in producing a very inferior kind of butter, white, hard, and brittle, and almoſt unfit for any culinary purpoſe whatever. The judicious farmer, therefore, will not attempt to imitate this practice, but will allow his cream to remain in the veſſel appropriated for keeping it, until it has acquired the proper degree of acidity. There is no rule for determining how long it is to be kept; but our author is of opinion, that a very great latitude is allowable in this caſe; and that if no ſerous matter be allowed to lodge among the cream, it may be kept good for making butter a great many weeks.

616 Of the churn.

The churn in which butter is made likewiſe admits of conſiderable diverſity; but our author prefers the old-faſhioned upright churn to all others, on account of its being more eaſily cleaned. The labour, when the cream is properly prepared, he thinks, very trifling. Much greater nicety, he ſays, is required in the proceſs of churning than moſt people are aware of; as a few haſty and irregular ſtrokes will render butter bad, which otherwiſe would have been of the fineſt quality. After the proceſs is over, the whole ought to be ſeparated from the milk, and put into a clean diſh, the inſide of which, if made of wood, ought to be well rubbed with common ſalt, to prevent the butter from adhering to it. The butter ſhould be preſſed and worked with a flat wooden ladle or ſkimming diſh, having a ſhort handle, ſo as to force out all the milk that was lodged in the cavities of the maſs. This operation requires a conſiderable degree of ſtrength as well as dexterity; but our author condemns the beating up of the butter with the hand as "an indelicate and barbarous practice." In like manner he condemns the employing of cold water in this operation, to *waſh* the butter as it is called. Thus, he ſays, the quality of it is debaſed in an aſtoniſhing degree. If it is too ſoft, it may be put into ſmall veſſels, and theſe allowed to ſwim in a tub of cold water; but the water ought never to touch the butter. The beating ſhould be continued till the milk be thoroughly ſeparated, but not till the butter become tough and gluey; and after this is completely done, it is next to be ſalted. The veſſel into which it is to be put muſt be well ſeaſoned with boiling water ſeveral times poured into it: the inſide is to be rubbed over with common ſalt, and a little melted butter poured into the cavity between the bottom and ſides, ſo as to make it even with the bottom; and it is then fit for receiving the butter. Inſtead of common ſalt alone, the doctor recommends the following compoſition. "Take of ſugar one part, of nitre one part, and of the beſt Spaniſh great ſalt two parts. Beat the

617 Butter ought not to be put into water.

618 Compoſition for preſerving butter.

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whole into a fine powder, mix them well together, and put them by for uſe. One ounce of this is to be thoroughly mixed with a pound of butter as ſoon as it is freed from the milk, and then immediately put into the veſſel deſigned to hold it; after which it muſt be preſſed ſo cloſe as to leave no air-holes; the ſurface is to be ſmoothed and covered with a piece of linen, and over that a piece of wet parchment; or, in defect of this laſt, fine linen that has been dipped in melted butter, exactly fitted to the edges of the veſſel all round, in order to exclude the air as much as poſſible. When quite full, the caſk is to be covered in like manner, and a little melted butter put round the edges, in order to fill up effectually every cranny, and totally to exclude the air. "If all this (ſays the doctor) be carefully done, the butter may be kept perfectly ſound in this climate for many years. How many years I cannot tell; but I have ſeen it two years old, and in every reſpect as ſweet and ſound as when only a month old. It deſerves to be remarked, that butter cured in this manner does not taſte well till it has ſtood at leaſt a fortnight after being ſalted; but after that period is elapſed, it eats with a rich marrowy taſte that no other butter ever acquires; and it taſtes ſo little ſalt, that a perſon who had been accuſtomed to eat butter cured with common ſalt only, would not imagine it had got one-fourth part of the ſalt neceſſary to preſerve it." Our author is of opinion, that ſtrong brine may be uſeful to pour upon the ſurface during the time it is uſing, in order the more effectually to preſerve it from the air, and to avoid rancidity.

As butter contains a quantity of mucilaginous matter much more putreſcible than the pure oily part, our author recommends the purifying it from this mucilage by melting in a conical veſſel, in which the mucilage will fall to the bottom; the pure oily part ſwimming at top. This will be uſeful when butter is to be ſent a long voyage to warm climates, as the pure part will keep much better than when mixed with the other. He propoſes another method of preſerving butter, viz. by mixing it with honey, which is very antiſeptic, and mixes intimately with the butter. Thus mixed, it eats very pleaſantly, and may perhaps be ſucceſsfully uſed with a medicinal intention.

619 To prepare butter for ſending to warm climates.

620 Preſerved by honey.

621 Epping butter.

In England no butter is eſteemed equal to that which is made in the county of Eſſex, well known by the name of Epping butter, and which in every ſeaſon of the year yields at London a much higher price than any other. The following directions concerning the making and management of butter, including the Epping method, are extracted from the 3d volume of the Bath Society Papers.

In general it is to be obſerved, that the greater the quantity made from a few cows, the greater will be the farmer's profit; therefore he ſhould never keep any but what are eſteemed good milkers. A bad cow will be equally expenſive in her keep, and will not perhaps (by the butter and cheeſe that is made from her) bring in more than from three to ſix pounds a-year; whereas a good one will bring from ſeven to ten pounds *per annum*: therefore it is obvious that bad cows ſhould be parted with, and good ones purchaſed in their room. When ſuch are obtained, a good ſervant ſhould be employed to milk them; as through the neglect and miſmanagement of ſervants, it frequently happens that the

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the beſt cows are ſpoiled. No farmer ſhould truſt entirely to ſervants, but ſometimes ſee themſelves that their cows are milked clean; for if any milk is ſuffered to remain in the udder, the cow will daily give leſs, till at length ſhe will become dry before the proper time, and the next ſeaſon ſhe will ſcarce give milk ſufficient to pay for her keep.

It ſometimes happens that ſome of a cow's teats may be ſcratched or wounded ſo as to produce foul or corrupted milk; when this is the caſe, we ſhould by no means mix it with the ſweet milk, but give it to the pigs; and that which is conveyed to the dairy-houſe ſhould remain in the pail till it is nearly cool, before it be ſtrained, that is, if the weather be warm; but in froſty weather it ſhould be immediately ſtrained, and a ſmall quantity of boiling water may be mixed with it, which will cauſe it to produce cream in abundance, and the more ſo if the pans or vats have a large ſurface.

During the hot ſummer months, it is right to riſe with or before the ſun, that the cream may be ſkimmed from the milk ere the dairy becomes warm; nor ſhould the milk at that ſeaſon ſtand longer in the vats, &c. than 24 hours, nor be ſkimmed in the evening till after ſunſet. In winter milk may remain unſkimmed for 36 or 48 hours; the cream ſhould be depoſited in a deep pan, which ſhould be kept during the ſummer in the cooleſt part of the dairy; or in a cool cellar where a free air is admitted, which is ſtill better. Where people have not an opportunity of churning every other day, they ſhould ſhift the cream daily into clean pans, which will keep it cool, but they ſhould never fail to churn at leaſt twice in the week in hot weather; and this work ſhould be done in a morning before the ſun appears, taking care to fix the churn where there is a free draught of air. If a pump-churn be to be uſed, it may be plunged a foot deep into a tub of cold water, and ſhould remain there during the whole time of churning, which will very much harden the butter. A ſtrong rancid flavour will be given to butter, if we churn ſo near the fire as to heat the wood in the winter ſeaſon.

After the butter is churned, it ſhould be immediately waſhed in many different waters till it is perfectly cleanſed from the milk; but here it muſt be remarked, that a warm hand will ſoften it, and make it appear greaſy, ſo that it will be impoſſible to obtain the beſt price for it. The cheeſemongers uſe two pieces of wood for their butter; and if thoſe who have a very hot hand were to have ſuch, they might work the butter ſo as to make it more ſaleable.

The Epping butter is made up for market in long rolls, weighing a pound each; in the county of Somerſet, they diſh it in half pounds for ſale; but if they forget to rub ſalt round the inſide of the diſh, it will be difficult to work it ſo as to make it appear handſome.

Butter will require and endure more working in winter than in ſummer; but it is remarked, that no perſon whoſe hand is warm by nature makes good butter.

Thoſe who uſe a pump-churn muſt endeavour to keep a regular ſtroke; nor ſhould they admit any perſon to aſſiſt them, except they keep nearly the ſame ſtroke: for if they churn more ſlowly, the butter will in the winter *go back*, as it is called; and if the ſtroke be more quick and violent in the ſummer, it will cauſe a fermentation, by which means the butter will imbibe a very diſagreeable flavour.

Where people keep many cows, a barrel-churn is to be preferred; but if this be not kept very clean, the bad effects will be diſcovered in the butter; nor muſt we forget to ſhift the ſituation of the churn when we uſe it, as the ſeaſons alter, ſo as to fix it in a warm place in winter, and where there is a free air in ſummer.

In many parts of this kingdom they colour their butter in winter, but this adds nothing to its goodneſs; and it rarely happens that the farmers in or near Epping uſe any colour; but when they do, it is very innocent. They procure ſome ſound carrots, whoſe juice they expreſs through a ſieve, and mix with the cream when it enters the churn, which makes it appear like May butter; nor do they at any time uſe much ſalt, though a little is abſolutely neceſſary.

As they make in that country but very little cheeſe, ſo of courſe very little whey butter is made; nor indeed ſhould any perſon make it, except for preſent uſe, as it will not keep good more than two days; and the whey will turn to better account to fatten pigs with. Nothing feeds theſe faſter, nor will any thing make them ſo delicately white. At the ſame time it is to be obſerved, that no good bacon can be made from pigs thus fatted; where much butter is made, good cheeſe for ſervants may be obtained from ſkimmed milk, and the whey will afterwards do for ſtore pigs.

622 West of England mode of making butter.

The foregoing rules will ſuffice for making good butter in any country; but as ſome people are partial to the weſt country method, it ſhall be deſcribed as briefly as poſſible.

In the firſt place, they depoſit their milk in earthen pans in their dairy-houſe, and (after they have ſtood twelve hours in the ſummer, and double that ſpace in the winter) they remove them to ſtoves made for that purpoſe, which ſtoves are filled with hot embers; on theſe they remain till bubbles riſe, and the cream changes its colour; it is then deemed heated enough, and this they call ſcalded cream; it is afterwards removed ſteadily to the dairy, where it remains 12 hours more, and is then ſkimmed from the milk and put into a tub or churn: if it be put into a tub, it is beat well with the hand, and thus they obtain butter; but a cleanlier way is to make uſe of a churn. Some ſcald it over the fire, but then the ſmoke is apt to affect it; and in either caſe, if the pans touch the fire, they will crack or fly, and the milk and cream will be waſted.

623 Cambridgeſhire butter.

The Cambridgeſhire ſalt butter is held in the higheſt eſteem, and is made nearly after the ſame method as the Epping; and by waſhing and working the ſalt from it the cheeſemongers in London often ſell it at a high price for freſh butter. They depoſite it when made into wooden tubs or firkins, which they expoſe to the air for two or three weeks, and often waſh them; but a readier way is to ſeaſon them with unſlaked lime, or a large quantity of ſalt and water well boiled will do: with this they muſt be ſcrubbed ſeveral times, and afterwards thrown into cold water, where they ſhould remain three or four days, or till they are wanted; then they ſhould be ſcrubbed as before, and well rinſed with cold water; but before they receive the butter, care

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care must be taken to rub every part of the firkin with salt: then if the butter be properly made, and perfectly sweet, it may be gently pressed into the firkin; but it must be well salted when it is made up, and the salt should be equally distributed through the whole mass, and a good handful of salt must be spread on the top of the firkin before it is heated, after which the head should be immediately put on.

624 Yorkshire and Suffolk butter.

They pursue nearly the same method in Suffolk and Yorkshire; nor is the butter that is made in these counties much inferior to that made in Cambridgeshire; indeed it is often sold in London for Cambridge butter: and no people make more butter from their cows than the Yorkshire farmers do, which is certainly owing to the care they take of their cows in the winter; as at that season they house them all, feed them with good hay, and never suffer them to go out (except to water) but when the weather is very serene; and when their cows calve, they give them comfortable malt messes for two or three days after; but these cows never answer if they are removed to other counties, except the same care and attendance be given them, and then none answer better.

Land whereon cows feed does very often affect the butter. If wild garlic, charlock, or May-weed, be found in a pasture ground, cows should not feed therein till after they have been mown, when such pernicious plants will appear no more till the following spring; but those cows that give milk must not partake of the hay made therefrom, as that will also diffuse its bad qualities.

Great part of the Epping butter is made from cows that feed during the summer months in Epping forest, where the leaves and shrubby plants contribute greatly to the flavour of the butter. The mountains of Wales, the highlands of Scotland, and the moors, commons, and heaths in England, produce excellent butter where it is properly managed; and though not equal in quantity, yet far superior in quality to that which is produced from the richest meadows; and the land is often blamed when the butter is bad through mismanagement, sluttishness, or inattention.

Turnips and rape affect milk and butter, but brewers grains are sweet and wholesome food, and will make cows give abundance of milk; yet the cream thereon will be thin, except good hay be given at the same time, after every meal of grains. Coleworts and cabbages are also excellent foods; and if these and savoys were cultivated for this purpose, the farmers in general would find their account in it.

Cows should never be suffered to drink improper water; stagnated pools, water wherein frogs, &c. spawn, common sewers, and ponds that receive the drainings of stables, are improper.

625 Frauds in the sale of butter.

Divers abuses are committed in the packing and salting of butter, to increase its bulk and weight, against which we have a statute express. Pots are frequently laid with good butter for a little depth at the top, and with bad at the bottom; sometimes the butter is set in rolls, only touching at top, and standing hollow at bottom. To prevent these cheats, the factors at Utoxeter keep a surveyor, who, in case of suspicion, tries the pots with an iron instrument called a *butter-bore*, made like a cheese-taster, to be stuck in obliquely to the bottom.

626 How butter may be kept untainted by cabbages and turnips.

In the Annals of Agriculture, vol. xvii. the following mode of preventing butter and cream from receiving a taint from the cows feeding on cabbages and turnips is stated by J. Jones Esq. of Bolas-heath, Newport, Shropshire. "I find by experience (says he) that a small bit of saltpetre, powdered and put into the milk-pan, with the new milk, does effectually prevent the cream and butter from being tainted, although the cows be fed on the refuse leaves of cabbages and turnips. In the beginning of this last winter, my men were very careful in not giving to the cows any outside or decayed leaves of the cabbages or turnips; yet the cream and butter were sadly tainted: but as soon as the maid used the saltpetre, all the taint was done away; and afterwards no care was taken in feeding the cows, for they had cabbages and turnips in all states. Our milk-pans hold about nine pints of milk."

627 Extent of the butter trade.

The trade in butter is very considerable. Some compute 50,000 tons annually consumed in London. It is chiefly made within 40 miles round the city. Fifty thousand firkins are said to be sent yearly from Cambridge and Suffolk alone; each firkin containing 56 lbs. Utoxeter in Staffordshire is a market famous for good butter, insomuch that the London merchants have established a factory there for that article. It is bought by the pot, of a long cylindrical form, weighing 14lb.

628 Cheese described.

The other grand object of the dairy is cheese-making. Cheese is the curd of milk, precipitated or separated from the whey by an acid. Cheese differs in quality according as it is made from new or skimmed milk, from the curd which separates spontaneously upon standing, or that which is more speedily produced by the addition of runnet. Cream also affords a kind of cheese, but quite fat and butyraceous, and which does not keep long. Analyzed chemically, cheese appears to partake much more of an animal nature than butter, or the milk from which it was made. It is insoluble in every liquid except spirit of nitre, and caustic alkaline ley. Shaved thin, and properly treated with hot water, it forms a very strong cement if mixed with quicklime *. When prepared with the hot water, it is recommended in the Swedish memoirs to be used by anglers as a bait. It may be made into any form, is not softened by the cold water, and the fishes are fond of it. As a food, physicians condemn the too free use of cheese. When new, it is extremely difficult of digestion: when old, it becomes acrid and hot; and, from Dr Percival's experiments, is evidently of a septic nature. It is a common opinion that old cheese digests every thing, yet is left undigested itself; but this is without any solid foundation. Cheese made from the milk of sheep digests sooner than that from the milk of cows, but is less nourishing; that from the milk of goats digests sooner than either, but is also the least nourishing. In general, it is a kind of food fit only for the laborious, or those whose organs of digestion are strong.

* See *Cement*.

Every country has places noted for this commodity: thus Chester and Gloucester cheese are famous in England; and the Parmesan cheese is in no less repute abroad, especially in France. This sort of cheese is entirely made of sweet cow-milk: but at Rochefort in Languedoc, they make it of ewe's milk; and in other places it is usual to add goat or ewe's milk in a certain proportion to that of the cow. There is likewise a kind

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kind of medicated cheese made by intimately mixing the expressed juice of certain herbs, as sage, baum, mint, &c. with the curd before it is fashioned into a cheese. The Laplanders make a sort of cheese of the milk of their rein-deer; which is not only of great service to them as food, but on many other occasions. It is a very common thing in these climates to have a limb numbed and frozen with the cold: their remedy for this is the heating an iron red hot, and thrusting it through the middle of one of these cheeses; they catch what drops out, and with this anoint the limb, which soon recovers. They are subject also to coughs and diseases of the lungs, and these they cure by the same sort of medicine: they boil a large quantity of the cheese in the fresh deer's milk, and drink the decoction in large draughts warm several times a-day. They make a less strong decoction of the same kind also, which they use as their common drink, for three or four days together, at several times of the year. They do this to prevent the mischiefs they are liable to from their water, which is otherwise their constant drink, and is not good.

629 Making of cheese.

In making cheese the same precaution is to be observed as with regard to butter, viz. the milk ought not to be agitated by carrying to any distance; nor ought the cows to be violently driven before they are milked, which reduces the milk almost to the same state as if agitated in a barrel or churn. To this cause Mr Twamley, who has written a treatise upon dairy management, attributes the great difficulty sometimes met with in making the milk coagulate; four or five hours being sometimes necessary instead of one (the usual time employed); and even after all, the curd will be of such a soft nature, that the cheese will swell, puff up, and rent in innumerable places, without ever coming to that solid consistence which it ought to have. As this frequently happens in consequence of heat, Mr Twamley advises to mix a little cold spring water with the milk. It is a bad practice to put in more runnet when the curd appears difficult to be formed, for this, after having once formed the curd by the use of a certain quantity, will dissolve it again by the addition of more.

630 General defects of cheese.

The most common defects of cheese are its appearing when cut full of small holes called *eyes*; its puffing up, cracking, and pouring out quantities of thin serous liquor; becoming afterwards rotten and full of maggots in those places from which the liquor issued. All this, according to our author, proceeds from the formation of a substance called by him *slip curd*, a kind of half coagulum, incapable of a thorough union with the true curd, and which when broken into very small bits produces *eyes*; but if in larger pieces, occasions those rents and cracks in the cheese already mentioned; for though this kind of curd retains its coagulated nature for some time, it always sooner or later dissolves into a serous liquid. This kind of curd may be produced, 1. By using the milk too hot. 2. By bad runnet. 3. By not allowing the curd a proper time to form. The first of these is remedied by the use of cold water, which our author says is so far from being detrimental to the quality of the cheese, that it really promotes the action of the runnet upon the milk. The second, viz. a knowledge of good from bad runnet, can only be acquired by long practice, and no particular directions can be given, farther than that the utmost care must be taken that it have no putrid tendency, nor any rancidity from too great heat in drying. The only rule that can be given for its preparation is to take out the maw of a calf which has fed entirely upon milk; after it is cold, swill it a little in water; rub it well with salt; then fill it with the same, and afterwards cover it. Some cut them open and spread them in salt, putting them in layers above one another, letting them continue in the brine they produce, sometimes stirring or turning them for four, six, or nine months; after which they are opened to dry, stretched out upon sticks or splints. They may be used immediately after being dried, though it is reckoned best to keep them till they be a year old before they are used. The best method of making the runnet from the skins, according to our author, is the following: "Take pure spring water, in quantity proportioned to the runnet you intend to make; it is thought best by some two skins to a gallon of water; boil the water, which makes it softer or more pure; make it with salt into brine that will swim an egg: then let it stand till the heat is gone off to about the heat of blood-warm; then put your maw-skin in, either cut in pieces or whole; the former I should imagine best or most convenient; letting it steep 24 hours, after which it will be fit for use. Such quantity as is judged necessary must then be put into the milk; about a tea-cupful being necessary for ten cows milk; though in this respect very particular directions cannot be given."

631 Of preparing runnet.

632 Mr Hazard's receipt for runnet.

In the Bath Papers, Mr Hazard gives the following receipt for making runnet. "When the maw-skin is well prepared and fit for the purpose, three pints or two quarts of soft water, clean and sweet, should be mixed with salt, wherein should be put sweet brier, rose leaves and flowers, cinnamon, cloves, mace, and in short almost every sort of spice and aromatic that can be procured; and if these are put into two quarts of water, they must boil gently till the liquor is reduced to three pints, and care should be taken that this liquid is not smoked; it should be strained clear from the spices, &c. and when found not to be warmer than milk from the cow, it should be poured upon the vell or maw; a lemon may then be sliced into it, when it may remain a day or two; after which it should be strained again and put into a bottle, where, if well corked, it will keep good for twelve months or more; it will smell like a perfume, and a small quantity of it will turn the milk, and give the cheese a pleasing flavour." He adds, that if the vell or maw be salted and dried for a week or two near the fire, it will do for the purpose again almost as well as before.

633 Particulars to be observed in making of cheese.

In the making of cheese, supposing the runnet to be of a good quality, the following particulars must be observed: 1. The proper degree of heat. This ought to be what is called *milk-warm*, or, "a few degrees removed from coolness," according to Mr Twamley; considerably below the heat of milk taken from the cow. If too hot, it may be reduced to a proper temperature by cold water, as already mentioned. 2. The time allowed for the runnet to take effect. This, our author observes, ought never to be less than an hour and a half. The process may be accelerated, particularly by putting salt to the milk be-

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fore the runnet is added. Mr Twamley advises two handfuls to ten or twelve cows milk; but he assures us, that no bad consequence can follow from the curd being formed ever so soon; as it then only becomes more solid and fit for making cheese of a proper quality. 3. To prevent any difficulty in separating the curd from the whey, prepare a long cheese-knife from lath; one edge being sharpened to cut the curd across from top to bottom in the tub, crossing it with lines checkerwise: by which means the whey rises through the vacancies made by the knife, and the curd sinks with much more ease. A sieve has also been used with success, in order to separate the whey perfectly from the curd. 4. Having got the curd all firm at the bottom of the tub, take the whey from it; let it stand a quarter of an hour to drain before you put it into the vat to break it. If any bits of slip-curd swim among the whey, pour it all off together rather than put it among the cheese, for the reasons already given. Some dairy-women allow the curd to stand for two hours; by which time it is become of so firm a nature that no breaking is necessary: they have only to cut it in slices, put it into the vat, and work it well by squeezing thoroughly to make it sit close; then put it into the press. Our author, however, approves more of the method of breaking the curd, as less apt to make the cheese hard and horny. 5. When the whey is of a white colour, it is a certain sign that the curd has not subsided; but if the method just now laid down be followed, the whey will always be of a green colour; indeed this colour of the whey is always a certain criterion of the curd having been properly managed. 6. The best method of preventing cheese from heaving, is to avoid making the runnet too strong, to take care that it be clean, and not tainted; to be certain that the curd is fully come, and not to stir it before the air has had time to escape; a quantity of air being always discharged in this as in many other chemical processes. 7. Cheese is very apt to split in consequence of being "salted within," especially when the vat is about half filled. In this case the curd, though separated only in a small degree by the salt, never closes or joins as it ought to do. Mr Twamley prefers salting in the milk greatly to this method. 8. Dry cracks in cheese are generally produced by keeping curd from one meal to another, and letting the first become too stiff and hard before it is mixed with the other. 9. Curdly or wrinkle-coated cheese is caused by sour milk. Cheese made of cold milk is apt to be hard, or to break and fly before the knife. 10. Such coated cheese is caused by being made too cold, as cheese that is made in winter or late in autumn is apt to be, unless laid in a warm room after it is made.

634 Different kinds of cheese.

Cheese is of very different quality, according to the milk from which it is made: Thus, in Gloucestershire, what is called the *second* or *two-meal* cheese, is made from one meal of new milk and one of skimmed or old milk, having the cream taken away. Skimmed cheese or *flet-milk* cheese, is made entirely from skimmed milk, the cream having been taken off to make butter. It goes by the name of *Suffolk cheese*, and is much used at sea; being less liable to be affected by the heat of warm climates than the other kinds. A great deal of difference, however, is to be observed in the quality of it, which our author supposes to arise chiefly from greater care being taken in some places than in others.

Slip-coat or soft cheese is made entirely of slip-curd, and dissolves into a kind of creamy liquor; which is a demonstration of the nature of this curd, as already mentioned. It is commonly computed, that as much milk is required to make one pound of butter as two of cheese; and even more where the land is poor, and the pastures afford but little cream.

635 Double Gloucester.

Best methods of making cheese in England. The double Gloucester is a cheese that pleases almost every palate. The best of this kind is made from new, or (as it is called in that and the adjoining counties) *covered milk*. An inferior sort is made from what is called *half-covered milk;* though when any of these cheeses turn out to be good, people are deceived, and often purchase them for the best *covered milk cheese:* but farmers who are honest have them stamped with a piece of wood made in the shape of a heart, so that any person may know them.

It will be every farmer's interest (if he has a sufficient number of cows) to make a large cheese from one meal's milk. This, when brought in warm, will be easily changed or turned with the runnet; but if the morning or night's milk be to be mixed with that which is fresh from the cow, it will be a longer time before it turns, nor will it change sometimes without being heated over the fire, by which it often gets dust or soot, or smoke, which will give the cheese a very disagreeable flavour.

When the milk is turned, the whey should be carefully strained from the curd. The curd should be broken small with the hands; and when it is equally broken, it must be put by a little at a time into the vat, carefully breaking it as it is put in. The vat should be filled an inch or more above the brim, that when the whey is pressed out, it may not shrink below the brim; if it does, the cheese will be worth very little. But first, before the curd is put in, a cheese-cloth or strainer should be laid at the bottom of the vat: and this should be so large, that when the vat is filled with the curd, the ends of the cloth may turn again over the top of it. When this is done, it should be taken to the press, and there remain for the space of two hours, when it should be turned and have a clean cloth put under it and turned over as before. It must then be pressed again, and remain in the press six or eight hours; when it should again be turned and rubbed on each side with salt. After this it must be pressed again for the space of 12 or 14 hours more; when, if any of the edges project, they should be pared off: it may then be put on a dry board, where it should be regularly turned every day. It is a good way to have three or four holes bored round the lower part of the vat, that the whey may drain so perfectly from the cheese as not the least particle of it may remain.

The prevailing opinion of the people of Gloucestershire and the neighbouring counties is, that the cheeses will spoil if they do not scrape and wash them when they are found to be mouldy. But others think that suffering the mould to remain mellows them, provided they are turned every day. Those, however, who will have the mould off, should cause it to be removed with a clean dry flannel, as the washing the cheeses is

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Some people ſcald the curd: but this is a bad and mercenary practice; it robs the cheeſe of its fatneſs, and can only be done with a view to raiſe a greater quantity of whey butter, or to bring the cheeſes forward for ſale, by making them appear older than they really are.

As moſt people like to purchaſe high coloured cheeſe, it may be right to mix a little arnotto with the milk before it is turned. No cheeſe will look yellow without it; and though it does not in the leaſt add to the goodneſs, it is perfectly innocent in its nature and effects.

636 Chedder cheeſe. Chedder cheeſe is held in high eſteem; but its goodneſs is ſaid to be chiefly owing to the land whereon the cows feed, as the method of making it is the ſame as is purſued throughout Somerſetſhire, and the adjoining counties.

637 Cheſhire cheeſe. Cheſhire cheeſe is much admired; yet no people take leſs pains with the runnet than the Cheſhire farmers. But their cheeſes are ſo large as often to exceed one hundred pounds weight each; to this (and the age they are kept, the richneſs of the land, and the keeping ſuch a number of cows as to make ſuch a cheeſe without adding a ſecond meal's milk) their excellence may be attributed. Indeed they ſalt the curd (which may make a difference), and keep the cheeſes in a damp place after they are made, and are very careful to turn them daily.

The following account of the mode of making this cheeſe is ſtated in the Annals of Agriculture, by Mr John Chamberlaine of Cheſter. "The proceſs of making Cheſhire cheeſe is as follows, viz. on a farm capable of keeping 25 cows, a cheeſe of about ſixty pounds weight may be daily made, in the months of May, June, and July.

"The evening's milk is kept untouched until next morning, when the cream is taken off, and put to warm in a braſs pan heated with boiling water; then one-third part of that milk is heated in the ſame manner, ſo as to bring it to the heat of new milk from the cow; (This part of the buſineſs is done by a perſon who does not aſſiſt in milking the cows during that time.) Let the cows be milked early in the morning; then the morning's new milk and the night's milk, thus prepared, are put into a large tub together with the cream; then a portion of runnet that has been put into water milk-warm the evening before is put into the tub, ſufficient to coagulate the milk; and at the ſame time, if arnotto be uſed to colour the cheeſe, a ſmall quantity, as requiſite for colouring, (or a marigold or carrot infuſion) is rubbed very fine, and mixed with the milk, by ſtirring all together; then covering it up warm, it is to ſtand about half an hour, or until coagulated; at which time it is firſt turned over with a bowl, to ſeparate the whey from the curds, and broken ſoon after with the hand and bowl into very ſmall particles; the whey being ſeparated by ſtanding ſome time, is taken from the curd, which ſinks to the bottom; the curd is then collected into a part of the tub which has a ſlip or looſe board acroſs the diameter of the bottom of it, for the ſole uſe of ſeparating them; and a board is placed thereon, with weights, from ſixty to a hundred and twenty pounds, to preſs out the whey: when it is getting into a more ſolid conſiſtence, it is cut, and turned over in ſlices ſeveral times, to extract all the whey, and then weighted as before; which operations may take up about an hour and a half. It is then taken from the tub, as near the ſide as poſſible, and broken very ſmall by hand, and ſalted, and put into a cheeſe vat, enlarged in depth by a tin hoop to hold the quantity, it being more than bulk when finally put into the preſs. Then preſs the ſide well by hand, and with a board at top well weighted; and placing wooden ſkewers round the cheeſe to the centre, and drawing them out frequently, the upper part of the cheeſe will be drained of its whey: then ſhift it out of the vat; firſt put a cloth upon the top of it, and reverſe it on the cloth into another vat, or the ſame, which vat ſhould be well ſcalded before the cheeſe is returned into it; then the top part is broken by hand down to the middle, and ſalt mixed with it, and ſkewered as before, then preſſed by hand, weighted, and all the whey extracted. This done, reverſe the cheeſe again into another vat, warmed as before, with a cloth under it; then a tin hoop or binder is put round the upper edge of the cheeſe and within the ſides of the vat, the cheeſe being firſt incloſed in a cloth, and the edges of it put within the vat.

"N. B. The cloth is of fine hemp, one yard and a half long by one yard wide. It is ſo laid, that on one ſide of the vat it ſhall be level with the ſide of it, on the other it ſhall lap over the whole of the cheeſe, and the edges put within the vat; and the tin fillet to go over the whole. All the above operations will take from ſeven in the morning till one at noon. Finally, it is put into a preſs of fifteen or twenty cwt. and ſtuck round the vat into the cheeſe with thin wire ſkewers, which are ſhifted occaſionally. In four hours more, it ſhould be ſhifted and turned, and in four hours more, the ſame, and the ſkewering continued. Next morning, let it be turned by the woman who attends the milk, and put under another or the ſame preſs, and ſo turned at night and the next morning; at noon, taken out finally to the ſalting room, there ſalt the outſide, and put a cloth binder round it. The cheeſe ſhould, after ſuch ſalting, be turned twice a-day for ſix or ſeven days, then left two or three weeks to dry, turned and cleaned every day, taken to the common cheeſe room, laid on ſtraw on a boarded floor, and daily turned until grown hard.

"The room ſhould be moderately warm; but no wind or draught of air ſhould be permitted, which generally cracks them. Some rub the outſides with butter or oil to give them a coat.

"The ſpring-made cheeſe is often ſhipped for the London market in the following autumn, and it is ſuppoſed to be much ameliorated by the heating on board the veſſel."

But of all the cheeſe this kingdom produces, none is more highly eſteemed than the Stilton, which is called the *Parmeſan* of England, and (except faulty) is never ſold for leſs than 1s. or 1s. 2d. per pound. 638 Stilton cheeſe.

The Stilton cheeſes are uſually made in ſquare vats, and weigh from ſix to twelve pounds each cheeſe. Immediately after they are made, it is neceſſary to put them into ſquare boxes made exactly to fit them; they being ſo extremely rich, that except this precaution

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be taken they are apt to bulge out, and break asunder. They should be continually and daily turned in these boxes, and must be kept two years before they are properly mellowed for sale.

Some make them in a net somewhat like a cabbage net; so that they appear, when made, not unlike an acorn. But these are never so good as the other, having a thicker coat, and wanting all that rich flavour and mellowness which make them so pleasing.

It is proper to mention that the making of these cheeses is not confined to the Stilton farmers, as many others in Huntingdonshire (not forgetting Rutland and Northamptonshire) make a similar sort, sell them for the same price, and give all of them the name of *Stilton cheeses*.

Though these farmers are remarked for cleanliness, they take very little pains with the runnet, as they in general only cut pieces from the vell or maw, which they put into the milk, and move gently about with the hand, by which means it breaks or turns it so, that they easily obtain the curd. But if the method above described for making runnet were put in practice, they would make their cheese still better; at least they would not have so many faulty and unsound cheeses; for notwithstanding their cheeses bear such a name and price, they often find them so bad as not to be saleable; which is probably owing to their being so careless about the runnet.

It has been alleged, that as good cheese might be made in other counties, if people would adhere to the Stilton plan, which is this: They make a cheese every morning; and to this meal of new milk they add the cream taken from that which was milked the night before. This, and the age of their cheeses, have been supposed the only reasons why they are preferred to others; for from the nicest observation, it does not appear that their land is in any respect superior to that of other counties.

Excellent cream cheeses are made in Lincolnshire, by adding the cream of one meal's milk to milk which comes immediately from the cow; these are pressed gently two or three times, turned for a few days, and are then disposed of at the rate of 1s. per pound, to be eaten while new with radishes, salad, &c.

Many people give skimmed milk to pigs, but the whey will do equally well after cheeses are made from this milk; such cheeses will always sell for at least 2d. per pound, which will amount to a large sum annually where they make much butter. The peasants and many of the farmers in the north of England never eat any better cheese; and though they appear harder, experience hath proved them to be much easier of digestion than any new milk cheeses. A good market may always be found for the sale of them at Bristol.

639 Parmesan cheese.

Account of the making of Parmesan cheese; by Mr Zappa of Milan: in answer to queries from Arthur Young, Esq.

"Are the cows regularly fed in stables?"—From the middle of April, or sooner if possible, the cows are sent to pasture in the meadows till the end of November usually.

"Or only fed in stables in winter?"—When the season is past, and snow comes, they are put into stables for the whole winter, and fed with hay.

"Do they remain in the pasture from morning till night? or only in hot weather?"—Between nine and ten in the morning the cows are sent to water, and then to the pastures, where they remain four or five hours at most, and at three or four o'clock are driven to the stables if the season is fresh, or under porticoes if hot; where for the night, a convenient quantity of hay is given them.

"In what months are they kept at pasture the whole day?"—Mostly answered already: but it might be said, that no owner will leave his cattle, without great cause, in uncovered places at night. It happens only to the shepherds from the Alps, when they pass, because it is impossible to find stables for all their cattle.

"What is the opinion in the Lodesan, on the best conduct for profit in the management of meadows?"—For a dairy farm of 100 cows, which yields daily a cheese weighing 70 or 75 lb. of 28 ounces, are wanted 1000 perticas of land. Of these about 800 are standing meadows, the other 200 are in cultivation for corn and grass fields in rotation.

"Do they milk the cows morning and evening?"—Those that are in milk are milked morning and evening, with exception of such as are near calving.

"One hundred cows being wanted to make a Lodesan each day, it is supposed that it is made with the milk of the evening and the following morning; or of the morning and evening of the same day: how is it?"—The 100 cows form a dairy farm of a good large cheese; it is reckoned that 80 are in milk, and 20 with calves sucking, or near calving. They reckon one with the other about 32 boccalis of 32 oz. of milk. Such is the quantity for a cheese of about 70lb. of 28 ounces. They join the evening with the morning milk, because it is fresher than if it was that of the morning and evening of the same day. The morning milk would be 24 hours old when the next morning the cheese should be made.

"Do they skim or not the milk to make butter before they make the cheese?"—From the evening milk all the cream possible is taken away for butter, mascarponi (cream cheese), &c. The milk of the morning ought to be skimmed slightly; but every one skims as much cream as he can. The butter is sold on the spot immediately at 24 sous: the cheese at about 28 sous. The butter loses nothing in weight; the cheese loses one-third of it, is subject to heat, and requires expences of service, attention, warehouses, &c. before it is sold; and a man in two hours makes 45 or 50lb. of butter that is sold directly. However, it is not possible to leave much cream in the milk to make Lodesan cheese, called *grained cheese;* because if it is too rich, it does not last long, and it is necessary to consume it while young and sound.

"Is Parmesan or Lodesan cheese made every day in the year or not?"—With 100 cows it is. In winter, however, the milk being less in quantity, the cheese is of lesser weight, but certainly more delicate.

"After gathering or uniting the milk, either skimmed or not, what is exactly the whole operation?"—The morning of the 3d of March 1786, I have seen the whole operation, having gone on purpose to the spot to see the whole work from beginning to end. At 16 Italian hours, or ten in the morning, according to the

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the northern way to account hours, the ſkimming of that morning's milk, gathered only two hours before, was finiſhed. I did, meanwhile, examine the boiler or pot. At the top it was eight feet (Engliſh) diameter, or thereabout; and about five feet three inches deep, made like a bell, and narrowing towards the bottom to about two and one-half feet. They joined the cream produced that morning with the other produced by the milk of the evening before. That produced by this laſt milk was double in quantity to that of the morning milk, becauſe it had the whole night to unite, and that of the morning had only two hours to do it: in which it could not ſeparate much. Of the cream, ſome was deſtined to make maſcarponies (cream cheeſe), and they put the reſt into the machine for making butter. Out of the milk of the evening before and of that morning, that was all put together after ſkimming, they took and put into the boiler 272 boccali, and they put under it two faggots of wood; which being burnt, were ſufficient to give the milk a warmth a little ſuperior to lukewarm. Then the boiler being withdrawn from the fire, the foreman put into it the runnet, which they prepare in ſmall balls of one ounce each, turning the ball in his hand always kept in the milk entirely covered; and after it was perfectly diſſolved, he covered the boiler to keep the milk defended, that it might not ſuffer from the coldneſs of the ſeaſon, particularly as it was a windy day. I went then to look on the man that was making maſcarponies, &c. and then we went twice to examine if the milk was ſufficiently coagulated. At the 18 hours, according to the Italian clocks, or noon, the true manufactory of cheeſe began. The milk was coagulated in a manner to be taken from the boiler in pieces from the ſurface. The foreman, with a ſtick that had 18 points, or rather nine ſmall pieces of wood fixed by their middle in the end of it, and forming nine points on each ſide, began to break exactly all the coagulated milk, and did continue to do ſo for more than half an hour, from time to time examining it to ſee its ſtate. He ordered to renew the fire, and four faggots of willow branches were uſed all at once: he turned the boiler that the fire might act; and then the underman began to work in the milk with a ſtick, like the above, but only with four ſmaller ſticks at the top, forming eight points, four at each ſide, a ſpan long each point. In a quarter of an hour the foreman mixed in the boiler the proper quantity of ſaffron, and the milk was all in knobs, and finer grained than before, by the effect of turning and breaking the coagulation, or curd, continually. Every moment the fire was renewed or fed; but with a faggot only at a time, to continue it regular. The milk was never heated much, nor does it hinder to keep the hand in it to know the fineneſs of the grain, which refines continually by the ſtick-work of the underman. It is of the greateſt conſequence to mind when the grain begins to take a conſiſtence. When it comes to this ſtate, the boiler is turned from the fire, and the underman immediately takes out the whey, putting it into proper receivers. In that manner the grain ſubſides to the bottom of the boiler; and leaving only in it whey enough to keep the grain covered a little, the foreman extending himſelf as much as he can over and in the boiler, unites with his hands the grained milk, making like a body of paſte of it. Then a large piece of linen is run by him under that paſte, while another man keeps the four corners of it, and the whey is directly put again into the boiler, by which is facilitated the means of raiſing that paſte that is taken out of the boiler, and put for one quarter of an hour into the receiver where the whey was put before, in the ſame linen it was taken from the boiler; which boiler is turned again directly on the fire, to extract the maſcarpa (whey cheeſe); and is a ſecond product, eaten by poor people. After the paſte remained for a quarter of an hour in that receiver, it was taken out and turned into the wooden form called *ſaſſera*, without any thing elſe made than the rotundity, having neither top nor bottom. Immediately after having turned it into that round wooden form, they put a piece of wood like a cheeſe on it, putting and increaſing gradually weights on it, which ſerve to force out the remnant of the whey; and in the evening the cheeſe ſo formed is carried into the warehouſe, where, after 24 hours, they begin to give the ſalt. It remains in that warehouſe for 15 or 20 days; but in ſummer only from 8 to 12 days. Meanwhile the air and ſalt form the cruſt to it; and then it is carried into another warehouſe for a different ſervice. In the ſecond warehouſe they turn every day all the cheeſes that are not older than ſix months; and afterwards it is enough if they are only turned every 48 or 60 hours, keeping them clean, in particular, of that bloom which is inevitable to them, and which, if neglected, turns muſty, and cauſes the cheeſe to acquire a bad ſmell. The Lodeſan, becauſe it is a province watered, has a great deal of meadows, and abounds with cows, its product being moſtly in cheeſe, butter, &c. However, the province of Pavia makes a great deal of that cheeſe; and we Milaneſe do likewiſe the ſame from the ſide of Porte Toſa, Romana, Ticineſe, and Vercilino, becauſe we have fine meadows and dairy farms.

Making of Fruit-Liquors.

Sect. IX. *Making of Fruit-Liquors.*

640 Fruit-liquors.

These, as objects of Britiſh huſbandry, are principally two, *Cyder* and *Perry*; the manufacturing of which forms a capital branch in our fruit-counties, and of which the improvement muſt be conſidered as of great importance to the public, but particularly ſo to the inhabitants of thoſe diſtricts where theſe liquors conſtitute their common beverage.

641 Excellence of cyder and perry.

Cyder and perry, when genuine and in high perfection, are excellent vinous liquors, and are certainly far more wholeſome than many others which at preſent are in much higher eſtimation. When the muſt is prepared from the choiceſt fruit, and undergoes the exact degree of vinous fermentation requiſite to its perfection, the acid and the ſweet are ſo admirably blended with the aqueous, oily, and ſpirituous principles, and the whole ſo imbued with the grateful flavour of the rinds, and the agreeable aromatic bitter of the kernels, that it aſſumes a new character; grows lively, ſparkling, and exhilarating; and when completely mellowed by time, the liquor becomes at once highly delicious to the palate, and congenial to the conſtitution; ſuperior in every reſpect to moſt other Engliſh wines, and perhaps not inferior to many of the beſt foreign wines. Such (ſays Dr Fothergill*) would

* *Bath Papers*, vol. v. p. 343.

Making of Fruit-Liquors. would it be pronounced by all competent judges, were it not for the popular prejudice annexed to it as a cheap home-brewed liquor, and consequently within the reach of the vulgar. To compare such a liquor with the foreign fiery sophisticated mixtures often imported under the name of wines, would be to degrade it; for it certainly surpasses them in flavour and pleasantness, as much as it excels them in wholesomeness and cheapness. But rarely do we meet with perry or cyder of this superior quality. For what is generally sold by dealers and inn-keepers is a poor, meagre, vapid liquor, prone to the acetous fermentation, and of course very injurious to the constitution. Is it not very mortifying, after the experience of so many centuries, that the art of preparing those ancient British liquors should still be so imperfectly understood as to seem to be in its very infancy?—That throughout the principal cyder districts, the practice should still rest on the most vague indeterminate principles, and that the excellence of the liquor should depend rather on a lucky random hit, than on good management? Yet such appears to be really the case even among the most experienced cyder-makers of Herefordshire and Gloucestershire.

642 Art of making them not yet perfectly understood.

Mr Marshall, that nice observer of rural affairs, in his tour † through those counties (expressly undertaken for the purpose of inquiry on this subject), informs us, that scarcely two of these professional artists are agreed as to the management of some of the most essential parts of the process: That palpable errors are committed as to the time and manner of gathering the fruit—in laying it up—in neglecting to separate the unsound—and to grind properly the rinds and kernels, &c.: That the method of conducting the vinous fermentation, the most critical part of the operation, and which stamps the future value of the liquor, is by no means ascertained; while some promote the fermentation in a spacious open vat, others repress it by inclosing the liquor in a hogshead, or strive to prevent it altogether: That no determinate point of temperature is regarded, and that the use of the thermometer is unknown or neglected: That they are as little consistent as to the time of racking off; and whether this ought to be done only once, or five or six times repeated: That for fining down the liquor, many have recourse to that odious article, bullocks blood, when the intention might be much better answered by whites of eggs or isinglass. And, finally, that the capricious taste of particular customers is generally consulted, rather than the real excellence of the liquor; and consequently that a very imperfect liquor is often vended, which tends to reduce the price, to disgrace the vender, and to bring the use of cyder and perry into disrepute.

† *Rural Econ. of Gloucestershire*, ii. p. 308.

643 Errors pointed out.

The art of making vinous liquors is a curious chemical process; and its success chiefly depends on a dexterous management of the vinous fermentation, besides a close attention to sundry minute circumstances, the theory of which is perhaps not yet fully understood by the ablest chemists. Can we longer wonder then that so many errors should be committed by illiterate cyder-makers, totally unversed in the first principles of the chemical art? Some few, indeed, more enlightened than their brethren, and less bigotted to their own opinions, by dint of observation strike out improvements, and produce every now and then a liquor of superior quality, though perhaps far short of excellence, yet still sufficient to show what might possibly be accomplished by a series of new experiments conducted on philosophical principles. This might lead to successive improvements, till at length our English fruit-liquors might be carried to a pitch of perfection hitherto unknown, by which the demand, both at home and abroad, would soon be enlarged, the prices augmented according to the quality, the value of estates increased, and the health and prosperity of these counties proportionably advanced. This might also help to point out a method of correcting the imperfections of these liquors; and of meliorating those of a weak meagre quality, by safer and more effectual means than are now practised: and though nothing can fully compensate the defect of sunshine in maturing the saccharine juices in unfavourable seasons, yet probably such liquors might, without the dangerous and expensive method of boiling in a copper vessel, admit of considerable improvement by the addition of barm or other suitable ferment, as yet unknown in the practice of the cyder districts; or perhaps rather by a portion of rich must, or some wholesome sweet, as honey, sugar-candy, or even molasses, added in due proportion, previous to the fermentation. In fact, it appears from a late publication *, that the Germans are known to meliorate their thin harsh wines by an addition of concentrated must, not by evaporation, but by freezing. By this simple process they are made to emulate good French wines: a practice worthy of imitation, especially in the northern climates.

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644 Means of improvement.

* *Hopson's Chemistry.*

Cyder, as is well known, is made from apples, and *perry*, from pears only. The general method of preparing both these liquors is very much the same; and under the article CYDER a description will be given of the way in which those fruits are gathered, ground, and pressed. The mill is not essentially different from that of a common tanner's mill for grinding bark. It consists of a millstone from two and a half to four feet and a half in diameter, running on its edge in a circular stone trough, from nine to twelve inches in thickness, and from one to two tons in weight. The bottom of the trough in which this stone runs is somewhat wider than the thickness of the stone itself; the inner side of the groove rises perpendicularly, but the outer spreads in such a manner as to make the top of the trough six or eight inches wider than the bottom; by which means there is room for the stone to run freely, and likewise for putting in the fruit, and stirring it up while grinding. The bed of a middle-sized mill is about 9 feet, some 10, and some 12; the whole being composed of two, three, or four stones cramped together and finished after being cramped in this manner. The best stones are found in the forest of Dean; generally a dark, reddish gritstone, not calcareous; for if it were of a calcareous quality, the acid juice of the fruits would act upon it and spoil the liquor: a clean-grained grindstone grit is the fittest for the purpose. The runner is moved by means of an axle passing through the centre, with a long arm reaching without the bed of the mill, for a horse to draw by; on the other side is a shorter arm passing through the centre of the stone, as represented

645 Description of a cyder mill and mill-house.

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sented in the figure. An iron bolt, with a large head, passes through an eye, in the lower part of the swivel on which the stone turns, into the end of the inner arm of the axis; and thus the double motion of it is obtained, and the stone kept perfectly upright. There ought also to be fixed on the inner arm of the axis, about a foot from the runner, a cogged wheel working in a circle of cogs, fixed upon the bed of the mill. The use of these is to prevent the runner from sliding, which it is apt to do when the mill is full; it likewise makes the work more easy for the horse. These wheels ought to be made with great exactness. Mr Marshall observes, that it is an error to make the horse draw by traces: "The acting point of draught (says he), the horse's shoulder, ought for various reasons, to be applied immediately at the end of the arm of the axis; not two or three yards before it; perhaps of a small mill near one fourth of its circumference." The building in which the mill is enclosed ought to be of such a size, that the horse may have a path of three feet wide betwixt the mill and the walls; so that a middling-sized mill, with its horse-path, takes up a space of 14 or 15 feet every way. The whole dimensions of the mill-house, according to our author, to render it any way convenient, are 24 feet by 20: it ought to have a floor thrown over it at the height of seven feet; with a door in the middle of the front, and a window opposite, with the mill on one side and the press on the other side of the window. The latter must be as near the mill as convenience will allow, for the more easy conveying the ground fruit from the one to the other. The press, which is of a very simple construction, has its bed or bottom about five feet square. This ought to be made entirely either of wood or stone; the practice of covering it with lead being now universally known to be pernicious. It has a channel cut a few inches within its outer edge, to catch the liquor as it is expressed, and convey it to a lip formed by a projection on that side of the bed opposite to the mill; having under it a stone trough or wooden vessel, sunk within the ground, when the bed is fixed low, to receive it. The press is worked with levers of different lengths; first a short, and then a moderately long one, both worked by hand; and lastly, a bar eight or nine feet long worked by a capstan or windlass. The expence of fitting up a mill-house is not very great. Mr Marshall computes it from 20l. to 25l. and, on a small scale, from 10l. to 15l. though much depends on the distance and carriage of the stone: when once fitted up it will last many years.

The making of the fruit-liquors under consideration requires an attention to the following particulars. I. The fruit. II. The grinding. III. Pressing. IV. Fermenting. V. Correcting. VI. Laying up. VII. Bottling; each of which heads is subdivided into several others.

646 Management of the fruit.

I. In the *management of the fruit*, the following particulars are to be considered.

1. The time of gathering; which varies according to the nature of the fruit. The early pears are fit for the mill in September; but few apples are ready for gathering before Michaelmas; though, by reason of accidental circumstances, they are frequently manufactured before that time. For sale cyder, and keeping drink, they are suffered to hang upon the trees till fully ripe: and the middle of October is generally looked upon to be a proper time for gathering the stire-apple. The criterion of a due degree of ripeness is the fruit falling from the tree: and to force it away before that time, in Mr Marshall's opinion, is robbing it of some of its most valuable particles. "The harvesting of fruit (says he) is widely different in this respect from the harvesting of grain; which has the entire plant to feed it after its separation from the soil; while fruit, after it is severed from the tree, is cut off from all possibility of a further supply of nourishment; and although it may have reached its wonted size, some of its more essential particles are undoubtedly left behind in the tree." Sometimes, however, the fruits which are late in ripening are apt to hang on the tree until spoiled by frosts; though weak watery fruits seem to be most injured in this manner; and Mr Marshall relates an instance of very fine liquor being made from golden pippins, after the fruit had been frozen as hard as ice.

647 Method of gathering it.

2. The method of gathering. This, as generally practised, is directly contrary to the principle laid down by Mr Marshall, *viz.* beating them down with long slender poles. An evident disadvantage of this method is, that the fruit is of unequal ripeness; for the apples on the same trees will differ many days, perhaps even weeks, in their time of coming to perfection; whence some part of the richness and flavour of the fruit will be effectually and irremediably cut off. Nor is this the only evil to be dreaded; for as every thing depends on the fermentation it has to undergo, if this be interrupted, or rendered complex by a mixture of ripe and unripe fruits, and the liquor be not in the first instance sufficiently purged from its feculencies, it is difficult to clear the liquor afterwards. The former defect the cyder-makers attempt to remedy by a mixture of brown sugar and brandy, and the latter by bullocks blood and brimstone; but neither of these can be expected to answer the purpose very effectually. The best method of avoiding the inconveniences arising from an unequal ripening of the fruit is to go over the trees twice, once with a hook, when the fruit begins to fall spontaneously; the second time, when the latter are sufficiently ripened, or when the winter is likely to set in, when the trees are to be cleared with the poles above mentioned.

648 Maturing it, &c.

3. Maturing the gathered fruit. This is usually done by making it into heaps, as is mentioned under the article Cyder: but Mr Marshall entirely disapproves of the practice; because, when the whole are laid in a heap together, the ripest fruit will begin to rot before the other has arrived at that degree of artificial ripeness which it is capable of acquiring. "The due degree of maturation of fruit for liquor (he observes) is a subject about which men, even in this district, differ much in their ideas. The prevailing practice of gathering into heaps until the ripest begin to rot, is wasting the best of the fruit, and is by no means an accurate criterion. Some shake the fruit, and judge by the rattling of the kernels; others cut through the middle and judge by their blackness; but none of these appear to be a proper test. It is not the state of the kernels but of the flesh; not of a few individuals, but of the greater part of the prime-fruit, which renders the collective body

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dy fit or unfit to be fent to the mill. The moft rational teft of the ripenefs of the fruit, is that of the flefh having acquired fuch a degree of mellownefs, and its texture fuch a degree of tendernefs, as to yield to moderate preffure. Thus, when the knuckle or the end of the thumb can with moderate exertion be forced into the pulp of the fruit, it is deemed in a fit ftate for grinding."

4. Preparation for the mill. The proper management of the fruit is to keep the ripe and unripe fruit feparate from each other: but this cannot be done without a confiderable degree of labour; for as by numberlefs accidents the ripe and unripe fruits are frequently confounded together, there cannot be any effectual method of feparating them except by hand; and Mr Marfhall is of opinion, that this is one of the grand fecrets of cyder-making, peculiar to thofe who excel in the bufinefs; and he is furprifed that it fhould not before this time have come into common practice.

5. Mixing fruits for liquor. Our author feems to doubt the propriety of this practice; and informs us, that the finer liquors are made frem felect fruits; and he hints that it might be more proper to mix liquors after they are made, than to put together the crude fruits.

649 Grinding.

II. *Grinding*, and management of the fruit when ground.

1. For the greater convenience of putting the fruit into the mill, every mill-houfe fhould have a fruit-chamber over it, with a trap-door to lower the fruit down into the mill. The beft manner in which this can be accomplifhed, is to have the valve over the bed of the mill, and furnifhed with a cloth fpout or tunnel reaching down to the trough in which the ftone moves. No ftraw is ufed in the lofts; but fometimes the fruit is turned. In Herefordfhire, it is generally believed, that grinding the rind and feeds of the fruit as well as the flefhy part to a pulp, is neceffary towards the perfection of the cyder; whence it is neceffary, that every kind of pains fhould be taken to perform the grinding in the moft perfect manner. Mr Marfhall complains, that the cyder-mills are fo imperfectly finifhed by the workmen, that for the firft *fifty years* they cannot perform their work in a proper manner. Inftead of being nicely fitted to one another with the fquare and chifel, they are hewn over with a rough tool in fuch a carelefs manner, that horfe-beans might lie in fafety in their cavities. Some even imagine this to be an advantage, as if the fruit was more effectually and completely broken by rough than fmooth ftones. Some ufe fluted rollers of iron; but thefe will be corroded by the juice, and thus the liquor might be tinged. Smooth rollers will not lay hold of the fruit fufficiently to force it through.

Another improvement requifite in the cyder-mills is to prevent the matter in the trough from rifing before the ftone in the laft ftage of grinding, and a method of ftirring it up in the trough more effectually than can be done at prefent. To remedy the former of thefe defects, it might perhaps be proper to grind the fruit firft in the mill to a certain degree; and then put it between two fmooth rollers to finifh the operation in the moft perfect manner. It is an error to grind too much at once; as this clogs up the mill, and prevents it from going eafily. The ufual quantity for a middle-fized mill is a bag containing four corn bufhels; but our author had once an opportunity of feeing a mill in which only half a bag was put; and thus the work feemed to go on more eafily as well as more quickly than when more was put in at once. The quantity put in at one time is to be taken out when ground. The ufual quantity of fruit ground in a day is as much as will make three hogfheads of perry or two of cyder.

2. Management of the ground fruit. Here Mr Marfhall condemns in very ftrong terms the practice of preffing the pulp of the fruit as foon as the grinding is finifhed; becaufe thus neither the rind nor feeds have time to communicate their virtues to the liquor. In order to extract thefe virtues in the moft proper manner, fome allow the ground fruit to lie 24 hours or more after grinding, and even regrind it, in order to have in the moft perfect manner the flavour and virtues of the feeds and rind.

650 Preffing, &c.

III. *Preffing the fruit*, and management of the *refiduum*. This is done by folding up the ground fruit in pieces of hair-cloth, and piling them up above one another in a fquare frame or mould, and then pulling down the prefs upon them, which fqueezes out the juice, and forms the matter into thin and almoft dry cakes. The firft runnings come off foul and muddy; but the laft, efpecially in perry, will be as clear and fine as if filtered through paper. It is common to throw away the refiduum as ufelefs: fometimes it is made ufe of when dry as fuel; fometimes the pigs will eat it, efpecially when not thoroughly fqueezed; and fometimes it is ground a fecond time with water, and fqueezed for an inferior kind of liquor ufed for the family. Mr Marfhall advifes to continue the preffure as long as a drop can be drawn. "It is found (fays he), that even by breaking the cakes of refufe with the hands only gives the prefs frefh power over it; for though it has been preffed to the laft drop, a gallon or more of additional liquor may be got by this means. Regrinding them has a ftill greater effect: In this ftate of the materials the mill gains a degree of power over the more rigid parts of the fruits, which in the firft grinding it could not reach. If the face of the runner and the bottom of the trough were dreffed with a broad chifel, and made true to each other, and a moderate quantity of refiduum ground at once, fcarcely a kernel could efcape unbroken, or a drop of liquor remain undrawn."

But though the whole virtue of the fruit cannot be extracted without grinding it very fine, fome inconvenience attends this practice, as part of the pulp thus gets through the haircloth, and may perhaps be injurious to the fubfequent fermentation. This, however, may be in a great meafure remedied by ftraining the firft runnings through a fieve. The whole fhould alfo be allowed to fettle in a cafk, and drawn off into a frefh veffel previous to the commencement of the fermentation. The reduced fruit ought to remain fome time between the grinding and preffing, that the liquor may have an opportunity of forming an extract with the rind and kernels: but this muft not be pufhed too far, as in that cafe the colour of the cyder would be hurt; and the moft judicious managers object to the pulp remaining longer than 12 hours without preffure. "Hence (fays our author), upon the whole, the moft eligible

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eligible management in this ſtage of the art appears to be this: Grind one preſsful a-day; preſs and regrind the reſiduum in the evening; infuſe the reduced matter all night among part of the firſt runnings; and in the morning repreſs while the next preſsful is grinding.

651 Fermentation.

IV. *Fermentation.* The common practice is to have the liquor turned; that is, put into caſks or hogſheads immediately from the preſs, and to fill them quite full: but it is undoubtedly more proper to leave ſome ſpace empty to be filled up afterwards. No accurate experiment has been made with regard to the temperature of the air proper to be kept up in the place where the fermentation goes on. Froſt is prejudicial: but when the proceſs uſually commences, that is, about the middle of October, the liquor is put into airy ſhades, where the warmth is ſcarce greater than in the open atmoſphere; nay, the caſks are frequently expoſed to the open air without any covering farther than a piece of tile or flat ſtone over the bunghole, propped up by a wooden pin on one ſide to cauſe the rain water to run off. In a complete manufactory of fruit-liquor, the fermenting room ſhould be under the ſame roof with the mill-houſe; a continuation of the preſs-room, or at leaſt opening into it, with windows or doors on every ſide, to give a free admiſſion of air into it; ſufficient defences againſt froſt; fruit-lofts over it, and vaults underneath for laying up the liquors after fermentation; with ſmall holes in the crown of the arch to admit a leathern pipe, for the purpoſe of conveying the liquors occaſionally from the one to the other.

In making of fruit-liquors, no ferment is uſed as in making of beer; though, from Mr Marſhall's account of the matter, it ſeems far from being unneceſſary. Owing to this omiſſion, the time of the commencement of the fermentation is entirely uncertain. It takes place ſometimes in one, two, or three days; ſometimes not till a week or month after turning: but it has been obſerved, that liquor which has been agitated in a carriage, though taken immediately from the preſs, will ſometimes paſs almoſt immediately into a ſtate of fermentation. The continuance of the fermentation is no leſs uncertain than the commencement of it. Liquors when much agitated, will go through it perhaps in one day; but when allowed to remain at reſt, the fermentation commonly goes on two or three days, and ſometimes five or ſix. The fermenting liquor, however, puts on a different appearance according to circumſtances. When produced from fruits improperly matured, it generally throws up a thick ſcum reſembling that of malt liquor, and of a thickneſs proportioned to the ſpecies and ripeneſs of the fruit; the riper the fruit, the more ſcum being thrown up. Perry gives but little ſcum, and cyder will ſometimes alſo do the ſame; ſometimes it is intentionally prevented from doing it.

After having remained ſome time in the fermenting veſſel, the liquor is racked or drawn off from the lees and put into freſh caſks. In this part of the operation alſo Mr Marſhall complains greatly of the little attention that is paid to the liquor. The ordinary time for racking perry is before it has done hiſſing, or ſometimes when it begins to emit fixed air in plenty. The only intention of the operation is to free the liquor from its fæces by a cock placed at a little diſtance from the bottom; after which the remainder is to be filtered through a canvas or flannel bag. This filtered liquor differs from the reſt in having a higher colour; having no longer any tendency to ferment, but on the contrary checking the fermentation of that which is racked off; and if it loſes its brightneſs, it is no longer eaſily recovered.—A freſh fermentation uſually commences after racking; and if it become violent, a freſh racking is neceſſary in order to check it; in conſequence of which the ſame liquor will perhaps be racked five or ſix times: but if only a ſmall degree of fermentation takes place, which is called *fretting*, it is allowed to remain in the ſame caſk; though even here the degree of fermentation which requires racking is by no means determined. Mr Marſhall informs us that the beſt manufacturers, however, repeat the rackings until the liquor will lie quiet, or nearly ſo; and if it be found impracticable to accompliſh this by the ordinary method of fermentation, recourſe muſt be had to fumigation with ſulphur, which is called *ſtumming* the caſks. For this fumigation it is neceſſary to have matches made of thick linen cloth about ten inches long, and an inch broad, thickly coated with brimſtone for about eight inches of their length. The caſk is then properly ſeaſoned, and every vent except the bunghole tightly ſtopped; a match is kindled, lowered down into the caſk, and held by the end undipped until it be well lighted and the bung be driven in; thus ſuſpending the lighted match within the caſk. Having burnt as long as the contained air will ſupply the fire, the match dies, the bung is raiſed, the remnant of the match drawn out, and the caſk ſuffered to remain before the liquor be put into it for two or three hours, more or leſs according to the degree of power the ſulphur ought to have. The liquor retains a ſmell of the ſulphureous acid; but this goes off in a ſhort time, and no bad effect is ever obſerved to follow.

In ſome places the liquor is left to ferment in open caſks, where it ſtands till the firſt fermentation be pretty well over; after which the froſt or yeaſt collected upon the ſurface is taken off, it being ſuppoſed that it is this yeaſt mixing with the clear liquor which cauſes it to fret after racking. The fermentation being totally ceaſed, and the lees ſubſided, the liquor is racked off into a freſh caſk, and the lees filtered as above directed. Our author mentions a way of fermenting fruit-liquors in broad ſhallow vats, not leſs than five feet in diameter, and little more than two feet deep; each vat containing about two hogſheads. In theſe the liquor remains until it has done riſing, or till the fermentation has nearly ceaſed, when it is racked off without ſkimming, the critical juncture being caught before the yeaſt fall; the whole ſinking gradually together as the liquor is drawn off. In this practice alſo the liquor is ſeldom drawn off a ſecond time.

652 Different kinds of cyder.

Cyder is made of three different kinds, viz. *rough*, *ſweet*, and *of a middle richneſs*. The firſt kind being uſually deſtined for ſervants, is made with very little ceremony. "If it is but *zeyder* (ſays Mr Marſhall), and has body enough to keep, no matter for the richneſs and flavour. The rougher it is, the further it will go, and the more acceptable cuſtom has rendered it not only to the workmen but to their maſters. A palate accuſtomed to ſweet cyder would judge the rough

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rough cyder of the farm-houſes to be a mixture of vinegar and water, with a little diſſolved alum to give it roughneſs." The method of producing this auſtere liquor is to grind the fruit in a crude under-ripe ſtate, and ſubject the liquor to a full fermentation.—For the ſweet liquor, make choice of the ſweeter fruits: mature them fully; and check the fermentation of the liquor.—To produce liquors of a middle richneſs, the nature of the fruit, as well as the ſeaſon in which it is matured, muſt be conſidered. The fruits to be made choice of are ſuch as yield juices capable of affording a ſufficiency both of richneſs and ſtrength; though much depends upon proper management. Open vats, in our author's opinion, are preferable to cloſe veſſels: but if caſks be uſed at all, they ought to be very large, and not filled; nor ought they to lie upon their ſides, but to be ſet on their ends with their heads out, and to be filled only to ſuch a height as will produce the requiſite degree of fermentation: but in whatever way the liquor be put to ferment, Mr Marſhall is of opinion that the operation ought to be allowed to go on freely for the firſt time; though after being racked off, any ſecond fermentation ought to be prevented as much as poſſible.

653 Of correcting or doctoring the liquors.

V. *Correcting*, provincially called *doctoring*. The imperfections which art attempts to ſupply in theſe liquors are, 1. Want of ſtrength; 2. Want of richneſs; 3. Want of flavour; 4. Want of colour and brightneſs.

The want of ſtrength is ſupplied by brandy or any other ſpirit in ſufficient quantity to prevent the acetous fermentation. The want of richneſs is ſupplied by what are generally termed *ſweets*, but prepared in a manner which our author ſays has never fallen under his notice. To ſupply the want of flavour, an infuſion of hops is ſometimes added, which is ſaid to communicate an agreeable bitter, and at the ſame time a fragrance; whence it becomes a ſubſtitute for the juices of the rind and kernels thrown away to the pigs and poultry, or otherwiſe waſted. The want of colour is ſometimes ſupplied by elder berries, but more generally by burnt ſugar, which gives the deſired colour, and a degree of bitter which is very much liked. The ſugar is prepared either by burning it on a ſalamander, and ſuffering it to drop, as it melts, into water; or by boiling it over the fire (in which caſe brown ſugar is to be uſed), until it acquire an agreeable bitter; then pouring in boiling water in the proportion of a gallon to two pounds of ſugar, and ſtir until the liquor become uniform. A pint of this preparation will colour a hogſhead of cyder. Brightneſs is obtained by a mixture of the blood of bullocks or ſheep; that of ſwine being rejected, though it does not appear to be more unfit for the purpoſe than either of the other two. The only thing neceſſary to be done here is to ſtir the blood well as it is drawn from the animal, to prevent the parts from ſeparating; and it ought to be ſtirred "both ways, for a quarter of an hour." The liquor, however, is not always in a proper condition for being refined with this ingredient: on which account a little of it ought frequently to be tried in a vial. A quart or leſs will be ſufficient for a hogſhead. After the blood is poured in, the liquor ſhould be violently agitated, to mix the whole intimately together. This is done by a ſtick ſlit into four, and inſerted into the bunghole; working it briſkly about in the liquor until the whole be thoroughly mixed. In about 24 hours the blood will be ſubſided, and the liquor ought inſtantly to be racked off; as by remaining upon the blood even for two or three days, it will receive a taint not eaſily to be got rid of. It is remarkable that this refinement with the blood carries down not only the fæces, but the colour alſo; rendering the liquor, though ever ſo highly coloured before, almoſt as limpid as water. Iſinglaſs and eggs are ſometimes made uſe of in fining cyder as well as wine.

654 Of laying up, or caſking.

VI. The *laying up* or ſhutting up the cyder in cloſe caſks, according to Mr Marſhall, is as little underſtood as any of the reſt of the parts; the bungs being commonly put in at ſome certain time, or in ſome particular month, without any regard to the ſtate the liquor itſelf is in. "The only criterion (ſays he) I have met with for judging the ciritical time of laying up, is when a fine white cream-like matter firſt begins to form upon the ſurface. But this may be too late; it is probably a ſymptom at leaſt of the acetous fermentation, which if it take place in any degree muſt be injurious. Yet if the caſks be bunged tight, ſome criterion is neceſſary; otherwiſe, if the vinous fermentation have not yet finally ceaſed, or ſhould recommence, the caſks will be endangered, and the liquor injured. Hence, in the practice of the moſt cautious manager whoſe practice I have had an opportunity of obſerving, the bungs are firſt driven in lightly, when the liquor is fine, and the vinous fermentation is judged to be over; and ſome time afterward, when all danger is paſt, to fill up the caſks, and drive the bungs ſecurely with a rag, and roſin them over at top. Moſt farmers are of opinion, that after the liquor is done fermenting, it ought to have ſomething to *feed upon*; that is, to prevent it from running into the acetous fermentation. For this purpoſe ſome put in parched beans, others egg-ſhells, ſome mutton ſuet, &c. Mr Marſhall does not doubt that ſomething may be uſeful; and thinks that iſinglaſs may be as proper as any thing that can be got.

655 Bottling.

VII. *Bottling*. This depends greatly on the quality of the liquors themſelves. Good cyder can ſeldom be bottled with propriety under a year old; ſometimes not till two. The proper time is when it has acquired the utmoſt degree of richneſs and flavour in the caſks; and this it will preſerve for many years in bottles. It ought to be quite fine at the time of bottling; or if not ſo naturally, ought to be fined artificially with iſinglaſs and eggs.

656 Of cyderkin.

The liquor, called *cyderkin*, *purre*, or *perkin*, is made of the murk or groſs matter remaining after the cyder is preſſed out. To make this liquor, the murk is put into a large vat, with a proper quantity of boiled water, which has ſtood till it be cold again: if half the quantity of water be uſed that there was of cyder, it will be good; if the quantities be equal, the cyderkin will be ſmall. The whole is left to infuſe 48 hours, and then well preſſed; what is ſqueezed out by the preſs is immediately tunned up and ſtopped; it is fit to drink in a few days. It clarifies of itſelf, and ſerves in families inſtead of ſmall beer. It will keep, if boiled, after preſſure, with a convenient quantity of hops.

657 Of cyder wine, according to Dr Ruſh's recipe.

We muſt not conclude this ſection without particular

Making of Fruit-Liquors.

cular notice of the liquor called *cyder wine*, which is made from the juice of apples taken from the prefs and *boiled*, and which being kept three or four years is faid to refemble Rhenifh. The method of preparing this wine, as communicated by Dr Rufh of America, where it is much practifed, confifts in evaporating in a brewing copper the frefh apple-juice till half of it be confumed. The remainder is then immediately conveyed into a wooden cooler, and afterwards is put into a proper cafk, with an addition of yeaft, and fermented in the ordinary way. The procefs is evidently borrowed from what has long been practifed on the recent juice of the grape, under the term of *vin cuit*, or boiled wine, not only in Italy, but alfo in the iflands of the Archipelago, from time immemorial.

This procefs has lately become an object of imitation in the cyder counties, and particularly in the weft of England, where it is reported that many hundred hogfheads of this wine have already been made: and as it is faid to betray no fign of an impregnation of copper by the ufual chemical tefts, it is confidered as perfectly wholefome, and is accordingly drunk without apprehenfion by the common people. Others, however, fufpect its innocence; whence it appeared an object of no fmall moment to determine in fo doubtful a matter, whether or not the liquor acquires any noxious quality from the copper in which it is boiled. With this view Dr Fothergill * made a variety of experiments; and the refult feemed to afford a ftrong prefumption that the cyder wine *does* contain a minute impregnation of copper; not very confiderable indeed, but yet fufficient, in the Doctor's opinion, to put the public on their guard concerning a liquor that comes in fo very "queftionable a fhape."

* *Bath Papers*, vol. v. p. 339.

It is a curious chemical fact, he obferves, if it be really true, that acid liquors, while kept boiling in copper veffels, acquire little or no impregnation from the metal, but prefently begin to act upon it when left to ftand in the cold. Can this be owing to the agitation accafioned by boiling, or the expulfion of the aerial acid? Atmofpheric air powerfully corrodes copper, probably through the intervention of the aerial or rather nitrous acid, for both are now acknowledged to be prefent in the atmofphere. But the latter is doubtlefs a much ftronger menftruum of copper than the former.

In the prefent procefs the liquor is properly directed to be paffed into a wooden cooler as foon as the boiling is completed. But as all acids, and even common water, acquire an impregnation and unpleafant tafte, from ftanding in copper veffels in the cold, why may not the acid juice of apples act in fome degree on the copper before the boiling commences? Add to this, that brewing coppers, without far more care and attention than is generally beftowed on them in keeping them clean, are extremely apt to contract verdigrife, (a rank poifon), as appears from the blue or green ftreaks very vifible when thefe veffels are minutely examined. Should the unfermented juice be thought incapable of acting on the copper either in a cold or boiling ftate, yet no one will venture to deny its power of wafhing off or diffolving verdigrife already formed on the internal furface of the veffel. Suppofe only one-eighth part of a grain of verdigrife to be contained in a bottle of this wine, a quantity that may elude the ordinary tefts, and that a bottle fhould be drunk daily by a perfon without producing any violent fymptoms or internal uneafinefs; yet what perfon in his fenfes would knowingly choofe to hazard the experiment of determining how long he could continue even this quantity of a flow poifon in his daily beverage with impunity? And yet it is to be feared the experiment is but too often unthinkingly made, not only with cyder wine, but alfo with many of the foreign wines prepared by a fimilar procefs. For the grape juice, when evaporated in a copper veffel, under the denomination of *vino cotto* or boiled wine, cannot but but acquire an equal, if not yet ftronger impregnation of the metal, than the juice of apples, feeing that verdigrife itfelf is manufactured merely by the application of the acid hufks of grapes to plates of copper.

Independent of the danger of any metallic impregnation, the Doctor thinks, it may be juftly queftioned how far the procefs of preparing boiled wines is neceffary or reconcileable to reafon or economy. The evaporation of them muft by long boiling not only occafion an unneceffary wafte of both liquor and fuel, but alfo diffipates certain effential principles, without which the liquor can never undergo a complete fermentation; and without a complete fermentation there can be no perfect wine. Hence the boiled wines are generally crude, heavy, and flat, liable to produce indigeftion, flatulency, and diarrhœa. If the evaporation be performed haftily, the liquor contracts a burnt empyreumatic tafte, as in the prefent inftance; if flowly, the greater is the danger of a metallic impregnation. For the procefs may be prefumed to be generally performed in a veffel of brafs or copper, as few families poffefs any other that is fufficiently capacious. Nor can a veffel of caft-iron, though perfectly fafe, be properly recommended for this purpofe, as it would probably communicate a chalybeate tafte and dark colour to the liquor. At all events, brafs and copper veffels ought to be entirely banifhed from this and every other culinary procefs.

SECT. X. *Of Fences.*

658 Kinds of fences enumerated.

WE fhall conclude the prefent fubject of agriculture by taking notice of the various kinds of fences that may be found valuable in it.—Robert Somerville, Efq. of Haddington, in a communication to the Board of Agriculture, has endeavoured to enumerate the whole fimple and compound fences that are at prefent ufed. *Simple fences* are thofe that confift of one kind only as a ditch, a hedge, or a wall.—*Compound fences* are made by the union of two or more of thefe, as a hedge and ditch, or hedge and wall. The following is the lift which he has given of them:

"*Simple Fences.*

I. Simple ditch, with a bank on one fide.
II. Double ditch, with a bank of earth between.
III. Bank of earth, with a perpendicular facing of fod.
IV. Ha-ha, or funk fence.
V. Palings, or *timber fences*, of different kinds, viz.
1. Simple nailed paling of rough timber.
2. Jointed horizontal paling.
3. Upright lath paling.

4. Horizontal

Fences.

4. Horizontal paling of young firs.
5. Upright ditto of do.
6. Chain fence.
7. Net fence.
8. Rope fence.
9. Flake or hurdle fence.
10. Ozier or willow fence.
11. Fence of growing posts.
12. Shingle fence, horizontal.
13. Ditto, upright.
14. Warped paling.
15. Open paling, warped with dead thorns or branches of trees.

VI. Dead hedges, various kinds.
VII. Live hedges.
VIII. Walls.

1. Dry stone wall, coped and uncoped.
2. Stone and lime ditto, do.
3. Stone and clay, do.
4. Stone and clay, harled, or dashed with lime.
5. Dry stone, ditto, lipped with lime.
6. Dry stone, ditto, lipped and harled.
7. Dry stone, pirned and harled.
8. Brick walls.
9. Frame walls.
10. Galloway dike or wall.
11. Turf wall.
12. Turf and stone, in alternate layers.
13. Mud walls, with straw.

" *Compound Fences.*

1. Hedge and ditch, with or without paling.
2. Double ditto.
3. Hedge and bank, with or without paling.
4. Hedge in the face of a bank.
5. Hedge on the top of a bank.
6. Devonshire fence.
7. Hedge, with single or double paling.
8. Hedge and dead hedge.
9. Hedge and wall.
10. Hedge, ditch, and wall.
11. Hedge in the middle of a wall.
12. Hedge and ditch, with row of trees.
13. Hedge, or hedge and wall, with belt of planting.
14. Hedge with the corners planted.
15. Reed fence, or port and rail, covered with reeds."

Of the nature of each of these, and the advantages attending the use of them, we shall take some short notice.

659 Ditches.

The ditch, which is one of the simple fences, is most frequently considered merely as an open drain intended to relieve the soil of superfluous moisture. It is frequently also, however, made use of without any such intention, as a fence for the confinement of cattle; but it is more frequently used with the double view of serving as a fence, and as a drain. It is made in a variety of ways, according to the object in view. If a ditch is meant to be used merely as a drain, the earth thrown out of it ought by no means to be formed into a bank upon the side of it, because such a practice, as formerly stated, when treating of draining, has a tendency to injure its utility by cutting off its communication with one side of the field to be drained; but when a ditch is intended to be used as a fence, a different rule of proceeding must be followed. In that case, the object in view will be greatly forwarded by forming the earth taken out of the ditch into a bank upon its side, which when added to the depth of the ditch, will form a barrier of considerable value.

Ditches are sometimes formed of an uniform breadth at top and bottom. This kind of ditch is liable to many objections. After frosts and rains, its sides are perpetually crumbling down and falling in, and if the field in which such a ditch is placed have a considerable declivity, the bottom of the ditch will be extremely liable to be undermined by any current of water, that either permanently or casually takes place in it; at the same time, such ditches have been found very useful in low-lying clay or carse soils where the country is level. From the nature of the soil, the sides of the ditches in such situations are tolerably durable. No rapid current of water can exist to undermine them; and, by their figure, they withdraw from the plough the smallest possible portion of surface.

Other ditches are constructed wide above, with a gradual slope from both sides downwards. This form of a ditch is in general the best, where it is at all to be used for the drainage of the field, as the sides are not so liable as in the former case to be excavated by the current of water. Hence it is more durable, and by diminishing the quantity of digging at the bottom, it is more easily executed.

A third kind of ditches are so formed as to have one side sloping, and the other perpendicular. This kind of ditch partakes of the whole perfections and imperfections of the two former. It is extremely useful, however, in fields of which sheep form a part of the stock, and where the bottom of the ditch contains a current of water; for, in such cases, when sheep tumble into a deep ditch, whose sides are pretty steep, they are very apt to perish; but by making one side of the ditch very much sloped, while the other approaches to the perpendicular, they are enabled to make their escape; while at the same time, by the bed of the stream being widened, the perpendicular side of the ditch is less liable to be undermined. When the earth taken out of a ditch is formed into a bank on one side, a projecting vacant space of 6 or 8 inches ought always to be left between the bank and the ditch, to prevent the earth from tumbling in and filling up the ditch.

A double ditch, with a bank of earth between the two, formed out of the earth obtained by digging them, has many obvious advantages over the single ditch, when considered as a fence; for the earth taken out of the two ditches, when properly laid up in the middle, will naturally become a very formidable rampart, which cattle will not readily attempt to cross. It is also excellently adapted for the purpose of open drainage, and it ought always to be used upon the sides of highways, where the adjoining lands have a considerable declivity towards the road. In such cases, the inner ditch receives the water from the field, and prevents it from washing down or overflowing the road in the time of heavy rains; an inconvenience which frequently cannot otherwise be avoided.

660 Bank of earth.

The bank of earth, with a perpendicular facing of sod, and a slope behind, is useful in some situations, as in making folds for the confinement of sheep or cattle, in which case the front or perpendicular side of the bank

Fences. bank muſt be turned inwards. It is alſo valuable on the ſides of highways to protect the adjoining fields, and alſo for fencing belts of planting, or incloſing ſtack-yards and cottages. The front of the bank is made with the turfs taken from the ſurface of the ſloping ditch, and the mound at the back with the earth taken out of it. This fence, when well executed, is ſaid to laſt a conſiderable time.

661 The ha-ha, or ſunk fence.

The ha-ha, or ſunk fence, very nearly reſembles the mound of earth with the perpendicular facing of turf, with this difference, that the facing of the ha-ha is of ſtone. The height of both depends almoſt entirely upon the depth of the ditch; both of them in truth conſiſt of the kind of ditch already mentioned, of which the one ſide ſlopes while the other is perpendicular, and differ from it chiefly in this reſpect, that the perpendicular ſide is faced with turf or ſtone. The ſtone-facing is made either of dry ſtone, or of ſtone and lime. In the Agricultural Report of Cromarty, the mode of making the ſunk fence is thus deſcribed: "Upon the line where this fence is intended, begin to ſink your ditch, taking the earth from as far as eight feet outward, and throwing it up on the inſide of the lines. This ditch and bank is not made quite perpendicular, but inclining inward towards the field as it riſes; to this is built a facing of dry ſtone, four feet and a half in height, one foot and three quarters broad at bottom, and one foot at top, over which a coping of turf is laid: the ditch or ſunk part forms an excellent drain. The whole of this is performed, when the ſtones (we ſhall ſuppoſe) can be procured at a quarter of a mile's diſtance, for 6d. per yard." The principal defect of the ſunk fence conſiſts in this, that unleſs the bank at the back of it is conſiderably ſteep, or has a railing at the top, it forms a kind of ſnare on that ſide for cattle, as they muſt always be apt to tumble over it in dark nights.

662 Palings.

Palings or timber fences, are in many places much uſed, though they never can be conſidered with propriety as forming permanent incloſures. Of whatever materials they are formed, their decay commences from the inſtant they are erected. This decay begins with the part of the paling that is put into the ground, which is ſpeedily rotted by the moiſture, or conſumed by worms or other animals that attack it. To guard as much as poſſible againſt this cauſe of decay, various devices have been adopted. It is a very general practice to burn the ſurface of that part of the ſtandards of the paling which is meant to be driven into the earth. It is alſo cuſtomary to cover the ſame part of the wood with a ſtrong coat of coarſe oil paint, and Lord Dundonald's coal varniſh has been recommended with this view. The points of the ſtandards that are to be fixed in the earth, ought to be dipped in the varniſh while it is boiling hot. Common tar or melted pitch have alſo been uſed with tolerable ſucceſs to defend the extremities of the ſtandards of paling. In ſome caſes where the expence could be afforded, large ſtones have been ſunk into the earth, with holes cut into them of a ſize adapted to receive the ends of the poſts of the paling. The durability of the wood in this caſe is greater, but it bears no proportion to the additional expence incurred. When poſts for paling can be obtained conſiſting of branches of trees, with the bark ſtill upon them, this natural covering enables them to remain uncorrupted for a longer period than can be accompliſhed by any artificial coating. It is no objection to this, that a part of the uncovered wood, or the bottom of the ſtake or poſt muſt be inſerted in the earth; for it is not at the bottom that ſtakes or poſts begin to decay, but at the uppermoſt place at which the earth touches them, or between the wet and the dry as it is called. Of the kinds of paling it is unneceſſary to ſay much.

The ſimple nailed paling of rough timber, conſiſts of poſts or ſtakes inſerted in the earth, and croſſed with three, four, or more horizontal bars or ſlabs as they are called in Scotland. It is the moſt common of all, and is uſed to protect young hedges, or to ſtrengthen ditches when uſed as fences.

The jointed horizontal paling, conſiſts of maſſy ſquare poles drove into the earth, and having openings cut into them for the reception of the extremities of the horizontal bars. Theſe openings, however, weaken the poles much, and cauſe them ſoon to decay; but this kind of paling has a very handſome and ſubſtantial appearance.

The upright lath paling, is formed by driving ſtrong piles of wood into the earth, and croſſing theſe at top and bottom, with horizontal pieces of ſimilar ſtrength. Upon theſe laſt are nailed, at every 6 or 12 inches diſtance, laths or pieces of ſawn wood, of the ſhape and ſize of the laths uſed for the roofs of tiled houſes. This kind of paling prevents cattle from putting their heads through to crop or injure young hedges or trees.

The horizontal paling of firs, or the weedings of other young trees, does not differ from the palings already deſcribed, unleſs in this reſpect, that the materials of which it is formed, conſiſt not of timber cut down for the purpoſe, but of the thinnings of woods or belts of planting. Such palings are uſually more formidable to cattle than any other, becauſe when the lateral twigs that grow out of large branches are loped off in a coarſe manner, the branch ſtill retains a roughneſs which keeps cattle at a diſtance.

The chain horizontal fence is made by fixing ſtrong piles of wood in the earth in the direction in which the fence is to run, and fixing three chains at regular diſtances, extending horizontally from pile to pile, inſtead of croſs bars of wood. Inſtead of poſts of wood, pillars of maſon work are ſometimes uſed, and between theſe the chains are extended. A chain fence will confine horſes or cattle, but is unfit to confine ſheep or hogs. From its expenſive nature, it can only be uſed in public walks, or for ſtretching acroſs ſtreams or pieces of water, where the incloſure can be completed in no other way.

The net fence is uſed for pleaſure grounds, and inſtead of chains, as in the former caſe, it conſiſts of a ſtrong net extended between upright piles. Such a fence may be a very pretty ornament, but could be of little uſe againſt the horns of cattle.

The rope fence is conſtructed like the chain fence, and differs from it only in the uſe of cords inſtead of metal chains, and has the ſame defect of being uſeleſs againſt ſwine and ſheep.

The moveable wooden fence or flake, or hurdle fence, conſiſts of a kind of moveable paling, uſed for confining ſheep or cattle to a certain ſpot when feeding upon a turnip field, and in this view it is extremely uſeful;

Fences.

uſeful; for if the cattle were allowed to range at large over the field, a great quantity of the turnips would be deſtroyed by having pieces eaten from them, which would immediately ſpoil and rot before the remainder could be conſumed; whereas, by the uſe of theſe moveable palings, the ſheep or cattle having only a certain quantity of food allotted to them at a time, are compelled to eat it clean up without any loſs.

The oſier or willow fence, or wattled fence, is made by driving in the direction of the fence, ſtakes of willow or poplar, of half the thickneſs of a man's wriſt into the earth, about 18 inches aſunder. They are then bound together with ſmall twigs of the willows or poplars twiſted and interwoven with them. If the upright ſtakes have been recently cut down, and if the fence is made about the end of autumn, they will take root and grow in the ſpring. If their new lateral branches are afterwards properly interwoven and twiſted together, they will become in two or three years a permanent and almoſt impenetrable fence.

The paling of growing trees, or rails nailed to growing poſts, is formed by planting beech, larch, or other trees, at the diſtance of a yard from each other, in the direction in which the fence is wanted. When 10 or 12 feet high, they muſt be cut down to 6 feet. The cutting of the tops will make them puſh out a great number of lateral branches, which may be interwoven with the upright part of the tree, as in the caſe of the willow fence already mentioned.

The horizontal and upright ſhingle fence is formed in this manner; ſtout piles are driven into the earth, and deals of from half an inch to an inch thick, are nailed horizontally upon them in ſuch a way, that the under edge of the uppermoſt deal projects over the upper edge of the one immediately below it, like ſlates or tiles upon houſes. In like manner, the ſhingles or boards may be placed perpendicularly and bound together, by being nailed to horizontal bars of wood.

The warped paling conſiſts of pieces of wood driven into the earth, which are twiſted and interwoven with each other, ſo as to form a very open net-work; the tops of the pieces of wood being bound together by willow or other twigs.

The light open fence with thorns, or branches of trees wove into it, is nothing more than a common paling, whoſe interſtices are filled up with thorns or branches of trees. It is a very effectual fence while it laſts.

Dead hedges are made of the prunings of trees, or the tops of live hedges that have been cut down. They are ſometimes made upon the top of the mound of earth taken out of a ditch, by inſerting the thick ends of the twigs in the earth, and making them reſt in an oblique manner. Sometimes the ſtronger pieces or ſtakes are fixed in the earth, and the ſmaller twigs are uſed to faſten them together at top, by a kind of network. What is called the ſtake and rue fence in Scotland, conſiſts of a dead hedge or fence, formed of upright poſts, the intervals between which are filled up with twigs woven horizontally. All theſe, however, can only be regarded as fences of a very temporary nature, which are conſtantly in want of repairs, and therefore requiring a continual expence.

663 General directions for planting hedges.

Before planting live hedges, it is proper to conſider the nature of the land, and what ſorts of plants will thrive beſt in it; and alſo, what is the ſoil from whence the plants are to be taken. As for the ſize, the ſets ought to be about the thickneſs of one's little finger, and cut within about four or five inches of the ground; they ought to be freſh taken up, ſtraight, ſmooth, and well-rooted. Thoſe plants that are raiſed in the nurſery are to be preferred.

In planting outſide hedges, the turf is to be laid, with the graſs-ſide downwards, on that ſide of the ditch on which the bank is deſigned to be made; and ſome of the beſt mould ſhould be laid upon it to bed the quick, which is to be ſet upon it a foot aſunder. When the firſt row of quick is ſet, it muſt be covered with mould; and when the bank is a foot high, you may lay another row of ſets againſt the ſpaces of the former, and cover them as you did the others: the bank is then to be topped with the bottom of the ditch, and a dry or dead hedge laid, to ſhade and defend the under-plantation. Stakes ſhould then be driven into the looſe earth, ſo low as to reach the firm ground: theſe are to be placed at about two feet and a half diſtance: and in order to render the hedge yet ſtronger, you may edder it, that is, bind the top of the ſtakes with ſmall long poles, and when the eddering is finiſhed, drive the ſtakes anew.

664 Of managing the hawthorn.

The quick muſt be kept conſtantly weeded, and ſecured from being cropped by cattle; and in February it will be proper to cut it within an inch of the ground, which will cauſe it ſtrike root afreſh, and help it much in the growth.

665 Of the crab.

The crab is frequently planted for hedges; and if the plants are raiſed from the kernels of the ſmall wild crabs, they are much to be preferred to thoſe raiſed from the kernels of all ſorts of apples without diſtinction; becauſe the plants of the true ſmall crab never ſhoot ſo ſtrong as thoſe of the apples, and may therefore be better kept within the proper compaſs of a hedge.

666 Black thorn.

The black thorn, or ſloe, is frequently planted for hedges; and the beſt method of doing it, is to raiſe the plants from the ſtones of the fruit, which ſhould be ſown about the middle of January, if the weather will permit, in the place where the hedge is intended; but when they are kept longer out of the ground, it will be proper to mix them with ſand, and keep them in a cool place. The ſame fence will do for it when ſown, as when it is planted.

667 Holly.

The holly is ſometimes planted for hedges; but where it is expoſed, there will be great difficulty in preventing its being deſtroyed: otherwiſe, it is by far the moſt beautiful plant; and, being an evergreen, will afford much better ſhelter for cattle in winter than any other ſort of hedge. The beſt method of raiſing theſe hedges, is to ſow the ſtones in the place where the hedge is intended; and, where this can be conveniently done, the plants will make a much better progreſs than thoſe that are tranſplanted: but theſe berries ſhould be buried in the ground ſeveral months before they are ſown. The way to do this, is to gather the berries about Chriſtmas, when they are uſually ripe, and put them into large flower-pots, mixing ſome ſand with them; then dig holes in the ground, into which the pots muſt be ſunk, covering them over with earth, about ten inches thick. In this place they muſt remain till the following October, when they ſhould be taken

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taken up, and ſown in the place where the hedge is intended to be made. The ground ſhould be well trenched, and cleared from the roots of all bad weeds, buſhes, trees, &c. Then two drills ſhould be made, at about a foot diſtance from each other, and about two inches deep, into which the ſeeds ſhould be ſcattered pretty cloſe, leſt ſome ſhould fail. When the plants grow up, they muſt be carefully weeded: and if they are deſigned to be kept very neat, they ſhould be cut twice a year, that is in May and in Auguſt; but if they are only deſigned for fences, they need only be ſheered in July. The fences for theſe hedges, while young, ſhould admit as much free air as poſſible; the beſt ſort are thoſe made with poſts and rails, or with ropes drawn through holes made in the poſts; and if the ropes are painted over with a compoſition of melted pitch, brown Spaniſh colour and oil, well mixed, they will laſt ſeveral years.

668 Of garden hedges.

Hedges for ornament in gardens are ſometimes planted with evergreens, in which caſe the holly is preferable to any other: next to this, moſt people prefer the yew; but the dead colour of its leaves renders thoſe hedges leſs agreeable. The laurel is one of the moſt beautiful evergreens; but the ſhoots are ſo luxuriant that it is difficult to keep it in any tolerable ſhape; and as the leaves are large, to prevent the diſagreeable appearance given them by their being cut through with the ſheers, it will be the beſt way to prune them with a knife, cutting the ſhoots juſt down to a leaf. The lauruſtinus is a very fine plant for this purpoſe; but the ſame objection may be made to this as to the laurel: this, therefore, ought only to be pruned with a knife in April when the flowers are going off; but the new ſhoots of the ſame ſpring muſt by no means be ſhortened. The ſmall-leaved and rough-leaved lauruſtinus are the beſt plants for this purpoſe. The true phillyrea is the next beſt plant for hedges, which may be led up to the height of 10 or 12 feet; and if they are kept narrow at the top, that there may be not too much width for the ſnow to lodge upon them, they will be cloſe and thick, and make a fine appearance. The ilex, or evergreen oak, is alſo planted for hedges, and is a fit plant for thoſe deſigned to grow very tall.—The deciduous plants uſually planted to form hedges in gardens are, the hornbeam, which may be kept neat with leſs trouble than moſt other plants. The beech, which has the ſame good qualities as the hornbeam; but the gradual falling of its leaves in winter cauſes a continual litter. The ſmall-leaved Engliſh elm is a proper tree for tall hedges, but theſe ſhould not be planted cloſer than eight or ten feet. The lime-tree has alſo been recommended for the ſame purpoſe; but after they have ſtood ſome years, they grow very thin at bottom, and their leaves frequently turn of a black diſagreeable colour.

669 Of flowering ſhrubs.

Many of the flowering ſhrubs have alſo been planted in hedges, ſuch as roſes, honeyſuckles, ſweet briar, &c. but theſe are difficult to train; and if they are cut to bring them within compaſs, their flowers, which are their greateſt beauty will be entirely deſtroyed. A correſpondent of the ſociety for improving agriculture in Scotland, however, informs us, that he tried with ſucceſs the eglantine, ſweet-briar, or dog-roſe, when all the methods of making hedges practiſed in Eſſex and Hampſhire had been tried in vain. His method was to gather the hips of this plant, and to lay them in a tub till March: the ſeeds were then eaſily rubbed out; after which they were ſowed in a piece of ground prepared for garden peaſe. Next year they came up; and the year after they were planted in the following manner. After marking out the ditch, the plants were laid about 18 inches aſunder upon the ſide graſs, and their roots covered with the firſt turfs that were taken off from the ſurface of the intended ditch. The earth ſide of theſe turfs was placed next to the roots, and other earth laid upon the turfs which had been taken out of the ditch. In four or five years theſe plants made a fence which neither horſes nor cattle of any kind could paſs. Even in two or three years none of the larger cattle will attempt a fence of this kind. Sheep indeed will ſometimes do ſo, but they are always entangled to ſuch a degree, that they would remain there till they died unleſs relieved. Old briars dug up and planted ſoon make an excellent fence; and, where thin, it may be eaſily thickened by laying down branches, which in one year will make ſhoots of ſix or ſeven feet. They bear clipping very well.

670 Dr Anderſon's directions.

Dr Anderſon, who hath treated the ſubject of hedging very particularly, is of opinion, that ſome other plants beſides thoſe above mentioned might be uſefully employed in the conſtruction of hedges. Among theſe he reckons the common willow. This, he ſays, by no means requires the wetneſs of ſoil which is commonly ſuppoſed. "It is generally imagined (ſays he), that the willow can be made to thrive nowhere except in wet or boggy ground: but this is one of thoſe vulgar errors, founded upon inaccurate obſervation, too often to be met with in ſubjects relating to rural affairs; for experience has ſufficiently convinced me, that this plant will not only grow, but thrive, in any rich well cultivated ſoil (unleſs in particular circumſtances that need not here be mentioned), even although it be of a very dry nature. It could not, however, in general be made to thrive, if planted in the ſame manner as thorns; nor would it, in any reſpect, be proper to train it up for a fence in the ſame way as that plant.

Eſſays on Agriculture, i. 54, &c.

671 Of the willow.

The willow, as a fence, could ſeldom be ſucceſsfully employed, but for dividing into ſeparate incloſures any extenſive field of rich ground: and, as it is always neceſſary to put the ſoil into as good order as poſſible before a hedge of this kind is planted in it, the eaſieſt method of putting it into the neceſſary high tilth, will be to mark off the boundaries of your ſeveral fields in the winter, or early in the ſpring, with a deſign to give a complete fallow to a narrow ridge, ſix or eight feet broad, in the middle of which the hedge is intended to be planted the enſuing winter. This ridge ought to be frequently ploughed during the ſummer ſeaſon, and in the autumn to be well manured with dung or lime, or both (for it cannot be made too rich), and be neatly formed into a ridge before winter.

"Having prepared the ground in this manner, it will be in readineſs to receive the hedge, which ought to be planted as early in winter as can be got conveniently done; as the willow is much hurt by being planted late in the ſpring. But before you begin to make a fence of this kind, it will be neceſſary to provide a ſufficient number of plants: which will be beſt

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done by previously rearing them in a nursery of your own, as near the field to be inclosed as you can conveniently have it; for as they are very bulky, the carriage of them would be troublesome if they were brought from any considerable distance. The best kinds of willow for this use, are such as make the longest and strongest shoots, and are not of a brittle nature. All the large kinds of hood-willows may be employed for this use; but there is another kind with stronger and more taper shoots, covered with a dark green bark when young, which, upon the older shoots, becomes of an ash gray, of a firm texture, and a little rough to the touch. The leaves are not so long, and a great deal broader than those of the common hoop-willow, pretty thick, and of a dark-green colour. What name this species is usually known by, I cannot tell; but as it becomes very quickly of a large size at the root, and is strong and firm, it ought to be made choice of for this purpose in preference to all other kinds that I have seen. The shoots ought to be of two or three years growth before they can be properly used, and should never be less than eight or nine feet in length. These ought to be cut over close by the ground immediately before planting, and carried to the field at their whole length. The planter having stretched a line along the middle of the ridge which was prepared for their reception, begins at one end thereof, thrusting a row of these plants firmly into the ground, close by the side of the line, at the distance of 18 or 20 inches from one another; making them all slant a little to one side in a direction parallel to the line. This being finished, let him begin at the opposite end of the line, and plant another row in the intervals between the plants of the former row; making these incline as much as the others, but in a direction exactly contrary; and then, plaiting these basket-ways, work them into lozenges like a net, fastening the tops by plaiting the small twigs with one another, which with very little trouble may be made to bind together very firmly. The whole, when finished, assumes a very beautiful net-like appearance, and is even at first a tolerable good defence; and, as these plants immediately take root and quickly increase in size, it becomes, after a few years, a very strong fence which nothing can penetrate. This kind of hedge I myself have employed; and find that a man may plant and twist properly about a hundred yards in a day, if the plants be laid down to his hand: and, in a situation such as I have described, I know no kind of fence which could be reared at such a small expence so quickly become a defence, and continue so long in good order. But it will be greatly improved by putting a plant of eglantine between each two plants of willow, which will quickly climb up and be supported by them; and, by its numerous prickles, would effectually preserve the defenceless willow from being browsed upon by cattle.

"As it will be necessary to keep the narrow ridge, upon which the hedge is planted, in culture for one year at least, that the plants of eglantine may not be choked by weeds, and that the roots of the willow may be allowed to spread with the greater ease in the tender mold produced by this means, it will be proper to sti: the earth once or twice by a gentle horse-hoe in the beginning of summer; and, in the month of June, it may be sowed with turnips, or planted with coleworts, which will abundantly repay the expence of the fallow."

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Of planting hedges in exposed situations, and recovering them when decayed.
Vol. ii. p. 16, &c.

The same author also gives the following useful directions for planting hedges in situations very much exposed to the weather, and recovering them when on the point of decaying. "Those who live in an open uncultivated country, have many difficulties to encounter, which others who inhabit more warm and sheltered regions never experience; and, among these difficulties, may be reckoned that of hardly getting hedges to grow with facility. For, where a young hedge is much exposed to violent and continued gusts of wind, no art will ever make it rise with so much freedom, or grow with such luxuriance, as it would do in a more sheltered situation and favourable exposure.

"But although it is impossible to rear hedges in this situation to so much perfection as in the others, yet they may be reared even there, with a little attention and pains, so as to become very fine fences.

"It is adviseable in all cases, to plant the hedges upon the face of a bank; but it becomes absolutely necessary in such an exposed situation as that I have now described: for the bank, by breaking the force of the wind, screens the young hedge from the violence of the blast, and allows it to advance, for some time at first, with much greater luxuriance than it otherwise could have done.

"But as it may be expected soon to grow as high as the bank, it behoves the provident husbandman to prepare for that event, and guard, with a wise forecast, against the inconvenience that may be expected to arise from that circumstance.

"With this view, it will be proper for him, instead of making a single ditch, and planting one hedge, to raise a pretty high bank, with a ditch on each side of it, and a hedge on each face of the bank; in which situation, the bank will equally shelter each of the two hedges while they are lower than it; and, when they at length become as high as the bank, the one hedge will in a manner afford shelter to the other, so as to enable them to advance with much greater luxuriance than either of them would have done singly.

"To effectuate this still more perfectly, let a row of service trees be planted along the top of the bank, at the distance of 18 inches from each other, with a plant of eglantine between each two services. This plant will advance, in some degree, even in this exposed situation; and by its numerous shoots, covered with large leaves, will effectually screen the hedge on each side of it, which, in its turn, will receive some support and shelter from them; so that they will be enabled to advance all together, and form, in time, a close, strong, and beautiful fence.

"The *service* is a tree but little known in Scotland; although it is one of those that ought perhaps to be often cultivated there in preference to any other tree whatever, as it is more hardy, and, in an exposed situation, affords more shelter to other plants than almost any other tree I know: for it sends out a great many strong branches from the under part of the stem, which, in time, assume an upright direction, and continue to advance with vigour, and carry many leaves to the

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the very bottom, almoſt as long as the tree exiſts: ſo that if it is not pruned, it riſes a large cloſe buſh, till it attains the height of a foreſt tree.

"It is of the ſame genus with the rawn-tree, and has a great reſemblance to it both in flower and fruit; its branches are more waving and pliant; its leaves undivided, broad, and round, ſomewhat reſembling the elm, but white and mealy on the under ſide. It deſerves to be better known than it is at preſent.

"But if, from the poorneſs of the ſoil in which your hedge is planted, or from any other cauſe, it ſhould ſo happen, that, after a few years, the hedge becomes ſickly, and the plants turn poor and ſtunted in appearance, the eaſieſt and only effectual remedy for that diſeaſe, is to cut the ſtems of the plants clean over, at the height of an inch or two above the ground; after which they will ſend forth much ſtronger ſhoots than they ever would have done without this operation. And if the hedge be kept free of weeds, and trained afterwards in the manner above deſcribed, it will, in almoſt every caſe, be recovered, and rendered freſh and vigorous.

"This amputation ought to be performed in autumn, or the beginning of winter; and in the ſpring, when the young buds begin to ſhow themſelves, the ſtumps ought to be examined with care, and all the buds be rubbed off, excepting one or two of the ſtrongeſt and beſt placed, which ſhould be left for a ſtem. For if the numerous buds that ſpring forth round the ſtem are allowed to ſpring up undiſturbed, they will become in a few years as weak and ſtunted as before; and the hedge will never afterwards be able to attain any conſiderable height, ſtrength, or healthfulneſs.— I have ſeen many hedges, that have been repeatedly cut over, totally ruined by this circumſtance not having been attended to in proper time.

"If the ground for ſixteen or twenty feet on each ſide of the hedge be fallowed at the time that this operation is performed, and get a thorough dreſſing with rich manures, and be kept in high order for ſome years afterwards by good culture and meliorating crops, the hedge will proſper much better than if this had been omitted, eſpecially if it had been planted on the level ground, or on the bank of a ſhallow ditch."

673 Of the black alder.

Mr Miller greatly recommends the black alder as ſuperior to any other that can be employed in moiſt ſoils. It may either be propagated by layers or truncheons about three feet long. The beſt time for planting theſe laſt is in February or the month of March. They ought to be ſharpened at their largeſt end, and the ground well looſened before they are thruſt into it, leſt the bark ſhould be torn off, which might occaſion their miſcarriage. They ſhould be ſet at leaſt two feet deep, to prevent their being blown out of the ground by violent winds after they have made ſtrong ſhoots; and they ſhould be kept clear of tall weeds until they have got good heads, after which they will require no farther care. When raiſed by laying down the branches, it ought to be done in the month of October; and by that time twelvemonth they will have roots ſufficient for tranſplantation, which muſt be done by digging a hole and looſening the earth in the place where the plant is to ſtand. The young ſets muſt be planted at leaſt a foot and a half deep; and their top ſhould be cut off to within about nine inches of the ground; by which means they will ſhoot out many branches. This tree may be trained into very thick and cloſe hedges, to the height of 20 feet and upwards. It will thrive exceedingly on the ſides of brooks; for it grows beſt when part of its roots are in water; and may, if planted there, as is uſual for willows, be cut for poles every fifth or ſixth year. Its wood makes excellent pipes and ſtaves; for it will laſt a long time under ground or in water: and it is likewiſe in great eſtimation among plough-wrights, turners, &c. as well as for making ſeveral of the utenſils neceſſary for agriculture. Its bark alſo dies a good black.

674 Of the birch.

The birch is another tree recommended by Mr Miller as proper for hedges; and in places where the young plants can be eaſily procured, he ſays that the plantation of an acre will not coſt 40 ſhillings, the after expence will not exceed 20 ſhillings: ſo that the whole will not come above three pounds. Aſh trees ought never to be permitted in hedges, both becauſe they injure the corn and graſs by their wide extended roots, and likewiſe on account of the property their leaves have of giving a rank taſte to butter made from the milk of ſuch cattle as feed upon the leaves. No aſh trees are permitted to grow in the good dairy-counties.

675 Of hedges raiſed on the top of ſtone fences.

Where there are plenty of rough flat ſtones, the fences which bound an eſtate or farm are frequently made with them. In Devonſhire and Cornwall it is common to build as it were two walls with theſe ſtones laid upon one another; firſt two and then one between: as the walls riſe they fill the intermediate ſpace with earth, beat the ſtones in flat to the ſides, which makes them lie very firm, and ſo proceed till the whole is raiſed to the intended height. Quick hedges, and even large timber trees, are planted upon theſe walls, and thrive extremely well. Such incloſures are reckoned the beſt defence that can be had for the ground and cattle; though it can ſcarce be ſuppoſed but they muſt be diſagreeable to the eye, and ſtand in need of frequent repairs, by the ſtones being forced out of the way by cattle. The beſt way to prevent this is to build ſuch wall in the bottom of a ditch made wide enough on purpoſe, and ſloped down on each ſide. Thus the deformity will be hid; and as the cattle cannot ſtand to face the wall ſo as to attempt to leap over it, the ſtones of which it is compoſed will be leſs liable to be beaten down. The earth taken out of the ditch may be ſpread on the adjacent ground, and its ſides planted with ſuch trees or underwood as will beſt ſuit the ſoil. By leaving a ſpace of ſeveral feet on the inſide for timber, a ſupply of that valuable commodity may be had without doing any injury to the more valuable paſture.

676 Method of conſtructing an excellent fence in graſſy places.

The following is an excellent method of making a durable and beautiful fence in graſſy places. Dig pieces of turf four or five inches thick, the breadth of the ſpade, and about a foot in length. Lay theſe turfs even by a line on one ſide, with the graſs outward, at the diſtance of ten or twelve inches within the mark at which the ditch afterwards to be dug in the ſolid ground is to begin. Then lay, in the ſame manner, but with their graſs ſides turned out the contrary way, another row of turfs, at ſuch a diſtance as to make a breadth of foundation proportioned to the intended height

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height of the bank. Thus, even though the ground ſhould prove defective, the bank would be prevented from giving way. A ditch may then be dug of what depth and breadth you pleaſe; or the ground may be lowered with a ſlope on each ſide; and in this caſe there will be no loſs of paſture by the fence; becauſe it may be ſowed with hay-ſeeds, and will bear graſs on both ſides. Part of the earth taken out of the ditches or ſlopes will fill the chaſm between the rows of turf, and the reſt may be ſcattered over the adjacent ground. Three, four, or more layers of turf, may be thus placed upon one another, and the interval between them filled up as before till the bank is brought to its deſired height; only obſerving to give each ſide of it a gentle ſlope for greater ſtrength. The top of this bank ſhould be about two feet and a half wide, and the whole of it filled up with earth, except a ſmall hollow in the middle to retain ſome rain. Quickſets ſhould then be planted along this top, and they will ſoon form an admirable hedge. By this means a bank four feet high, and a ſlope only two feet deep, will make, beſides the hedge, a fence ſix feet high, through which no cattle will be able to force their way: for the roots of the graſs will bind the turf ſo together, that in one year's time it will become entirely ſolid; and it will yet be much ſtronger when the roots of the quick ſhall have ſhot out among it. The only precautions neceſſary to be obſerved in making this bank are, 1. Not to make it when the ground is too dry; becauſe, if a great deal of wet ſhould ſuddenly follow, it will ſwell the earth ſo much as, perhaps, to endanger the falling of ſome of the outſide; which, however, is eaſily remedied if it ſhould happen. 2. If the ſlope be ſuch as ſheep can climb up, ſecure the young quicks, at the time of planting them, by a ſmall dead hedge, either on or near the top, on both ſides. If any of the quicks ſhould die, which they will hardly be more apt to do in this than in any other ſituation, unleſs perhaps in extremely dry ſeaſons, they may be renewed by ſome of the methods already mentioned.—Such fences will anſwer even for a park; eſpecially if we place poſts and rails, about two feet high, a little ſloping over the ſide of the bank, on or near its top: no deer can creep through this, nor even be able to jump over it. It is likewiſe one of the beſt fences for ſecuring cattle; and if the quicks on the banks be kept clipped, it will form a kind of green wall pleaſing to the eye.

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Elms recommended.

In the firſt volume of the Bath Papers we find elms recommended for fences; and the following method of raiſing them for this purpoſe is ſaid to be the beſt. When elm timber is felled in the ſpring, ſow the chips made in trimming or hewing them green, on a piece of ground newly ploughed, as you would corn, and harrow them in. Every chip which has an eye, or bud-knot, or ſome bark on it, will immediately ſhoot like the cuttings of potatoes; and the plants thus raiſed having no tap-roots, but ſhooting their fibres horizontally in the richeſt part of the ſoil, will be more vigorous, and may be more ſafely and eaſily tranſplanted, than when raiſed from ſeeds, or in any other method. The plants thus raiſed for elm fences have greatly the advantage of others; as five, ſix, and ſometimes more, ſtems will ariſe from the ſame chip; and ſuch plants if cut down within three inches of the ground, will multiply their ſide ſhoots in proportion, and make a hedge thicker, without running to naked wood, than by any other method yet practiſed. If kept clipped for three or four years, they will be almoſt impenetrable.

678
Obſervations on quick hedges.

In the ſecond volume of the ſame work, we meet with ſeveral obſervations on quick hedges by a gentleman near Bridgewater. He prefers the white and black thorns to all other plants for this purpoſe; but is of opinion, that planting timber trees in them at proper intervals is a very eligible and proper method. He raiſed ſome of his plants from haws in a nurſery; others he drew up in the woods, or wherever they could be found. His banks were made flat, and three feet wide at the top, with a ſloping ſide next the ditches, which laſt were dug only two feet below the ſurface, and one foot wide at bottom. The turfs were regularly laid, with the graſs downwards, on that ſide of the ditch on which the hedge was to be raiſed, and the beſt of the mould laid at top. The ſets were ſtraight, long, ſmooth, and even growing ones planted as ſoon as poſſible after taking up. They were planted at a foot diſtance; and about every 40 feet young fruit-trees or thoſe of other kinds, ſuch as aſh, oak, elm, beech, as the ſoil ſuited them. A ſecond row of quickſets was then laid on another bed of freſh earth at the ſame time, and covered with good mould; after which the bank was finiſhed and ſecured properly from injuries by a dead hedge well wrought together, and faſtened by ſtakes of oak-trees on the top of the bank at three feet diſtance. Wherever any of the quickſets had failed or were of a dwindling appearance, he had them replaced with freſh ones from the nurſery, as well as ſuch of the young trees as had been planted on the top of the bank; and cleared the whole from weeds. Thoſe moſt deſtructive to young hedges are the white and black bryony, bindweed, and the traveller's joy. The root of white bryony is as big as a man's leg, and runs very deep: that of black bryony often grows to 30 feet long, and with a kind of tendrils takes hold of the root of the young quick, and chokes it. This root muſt be dug very deep in order to deſtroy it. The third is ſtill more deſtructive to young quicks than the other two, overſhadowing the hedge like an arbour. Its root is ſmaller than that of the two former, but muſt be dug out very clean, as the leaſt piece left will ſend up freſh ſhoots. It is very deſtructive to hedges to allow cattle to browze upon them, which they are very apt to do; but where cattle of ſome kind muſt be allowed acceſs to them, horſes will do by far the leaſt miſchief.

679
Cyder fruit-trees recommended in hedges.

With regard to the advantage ariſing from hedges, our author obſerves, that "if they were of no farther uſe than as mere fences, it would be the farmer's intereſt to keep them up carefully; for the better they are, the more ſecure are his cattle and crops. But if a judicious mixture of cyder fruit-trees were planted in hedges, the profit ariſing from them only would abundantly repay the coſt of the whole without any loſs of ground. It may poſſibly be objected by ſome, that the hedges would often be hurt by the boys climbing up to get the fruit: but thoſe who make it ſhould remember, or be told, that the beſt kinds of cyder-fruit are ſo hard and auſtere at the time of their being gathered, that nobody can eat them, and even hogs

Fences. hogs will hardly touch them. But the greatest benefit, where no fruit-trees are planted, arises from the thorns and wood which quick hedges yield for the fire and other purposes."

680 Method of raising hornbeam hedges in Germany.

The author of the Essays on Husbandry recommends the hornbeam plant as one of the best yet known for making fences, according to the method practised in Germany, where such fences are common. "When the German husbandman (says he) erects a fence of this nature, he throws up a parapet of earth, with a ditch on each side, and plants his hornbeam sets in such a manner, that every two plants may be brought to intersect each other in the form of St Andrew's cross. In that part where the two plants cross each other, he gently scrapes off the bark, and binds them with straw thwartwise. Here the two plants consolidate in a kind of indissoluble knot, and push from thence horizontal slanting shoots, which form a sort of living palisado or *chevaux de frise*; so that such a protection may be called a rural fortification. The hedges being pruned annually, and with discretion, will in a few years render the fence impenetrable in every part.

681 Dr Anderson's method of mending decayed hedges.

"It sometimes happens (says Dr Anderson) that a hedge may have been long neglected, and be in general in a healthy state, but full of gaps and openings, or so thin and straggling, as to form but a very imperfect sort of fence. On these occasions, it is in vain to hope to fill up the gaps by planting young quicks; for these would always be outgrown, choked, and starved, by the old plants: nor could it be recovered by cutting clear over by the roots, as the gaps would still continue where they formerly were. The only methods that I know of rendering this a fence are, either to mend up the gaps with dead wood, or to *plash* the hedge; which last operation is always the most eligible where the gaps are not too large to admit of being cured by this means.

"The operation I here call *plashing*, may be defined, "a wattling made of living wood." To form this, some stems are first selected, to be left as stakes at proper distances, the tops of which are all cut over at the height of four feet from the root. The straggling side-branches of the other part of the hedge are also lopped away. Several of the remaining plants are then cut over, close by the ground, at convenient distances; and the remaining plants are cut perhaps half through, so as to permit them to be bent to one side. They are then bent down almost to a horizontal position, and interwoven with the upright stakes, so as to retain them in that position. Care ought to be taken that these be laid very low at those places where there were formerly gaps; which ought to be farther strengthened by some dead stakes or truncheons of willows, which will frequently take root in this case, and continue to live. And sometimes a plant of eglantine will be able to overcome the difficulties it there meets with, strike root, and grow up so as to strengthen the hedge in a most effectual manner.

"The operator begins at one end of the field, and proceeds regularly forward, bending all the stems in one direction, so that the points rise above the roots of the others, till the whole wattling is completed to the same height as the uprights.

"An expert operator will perform this work with much greater expedition than one who has not seen it done could easily imagine. And as all the diagonal wattlings continue to live and send out shoots from many parts of their stems, and as the upright shoots that rise from the stumps of those plants that have been cut over quickly rush up through the whole hedge, these serve to unite the whole into one entire mass, that forms a strong, durable, and beautiful fence.

"This is the best method of recovering an old neglected hedge that hath as yet come to my knowledge.

"In some cases it happens that the young shoots of a hedge are killed every winter; in which case it soon becomes dead and unsightly, and can never rise to any considerable height. A remedy for this disease may therefore be wished for.

"Young hedges are observed to be chiefly affected with this disorder; and it is almost always occasioned by an injudicious management of the hedge, by means of which it has been forced to send out too great a number of shoots in summer, that are thus rendered so small and weakly as to be unable to resist the severe weather in winter.

"It often happens that the owner of a young hedge, with a view to render it very thick and close, cuts it over with the shears a few inches above the ground the first winter after planting; in consequence of which, many small shoots spring out from each of the stems that has been cut over:—Each of which, being afterwards cut over in the same manner, sends forth a still greater number of shoots, which are smaller and smaller in proportion to their number.

"If the soil in which the hedge has been planted is poor, in consequence of this management, the branches, after a few years, become so numerous, that the hedge is unable to send out any shoots at all, and the utmost exertion of the vegetative powers enables it only to put forth leaves. These leaves are renewed in a sickly state for some years, and at last cease to grow at all—the branches become covered with fog, and the hedge perishes entirely.

"But if the soil be very rich, notwithstanding this great multiplication of the stems, the roots will still have sufficient vigour to force out a great many small shoots, which advance to a great length, but never attain a proportional thickness. And as the vigour of the hedge makes them continue to vegetate very late in autumn, the frosts come on before the tops of these dangling shoots have attained any degree of woody firmness, so that they are killed almost entirely by it: the whole hedge becomes covered with these long dead shoots, which are always disagreeable to look at, and usually indicate the approaching end of the hedge.

"The causes of the disorder being thus explained, it will readily occur, that the only radical cure is amputation; which, by giving an opportunity to begin with training the hedge anew, gives also an opportunity of avoiding the errors that occasioned it. In this case, care ought to be taken to cut the plants as close to the ground as possible, as there the stems will be less numerous than at any greater height. And particular attention ought to be had to allow very few shoots to arise from the stems that have been cut over, and to guard carefully against shortening them.

"But as the roots, in the case here supposed, will be

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be very ſtrong, the ſhoots that are allowed to ſpring from the ſtems will be very vigorous, and there will be ſome danger of their continuing to grow later in the ſeaſon than they ought in ſafety to do; in which caſe, ſome part of the top of the ſhoot may perhaps be killed the firſt winter, which ought if poſſible to be prevented. This can only be effectually done by giving a check to the vegetation in autumn, ſo as to allow the young ſhoots to harden in the points before the winter approaches. If any of the leaves or branches of a tree are cut away while it is in the ſtate of vegetation, the whole plant feels the loſs, and it ſuffers a temporary check in its growth in proportion to the loſs that it thus ſuſtains. To check, therefore, the vigorous vegetation at the end of autumn, it will be prudent to chooſe the beginning of September for the time of lopping off all the ſupernumerary branches from the young hedge, and for clipping off the ſide-branches that have ſprung out from it; which will, in general, be ſufficient to give it ſuch a check in its growth at that ſeaſon, as will prevent any of the ſhoots from advancing afterwards. If the hedge is extremely vigorous, a few buds may be allowed to grow upon the large ſtumps in the ſpring, with a view to be cut off at this ſeaſon, which will tend to ſtop the vegetation of the hedge ſtill more effectually.

"By this mode of management, the hedge may be preſerved entire through the firſt winter. And as the ſhoots become leſs vigorous every ſucceſſive ſeaſon, there will be leſs difficulty in preſerving them at any future period. It will always be proper, however, to trim the ſides of a very vigorous hedge for ſome years while it is young, about the ſame ſeaſon of the year, which will tend powerfully to prevent this malady. But when the hedge has advanced to any conſiderable height, it will be equally proper to clip it during any of the winter-months, before Candlemas."

682 Lord Kames's obſervations.

Lord Kames, in his work entitled the Gentleman Farmer, gives ſeveral directions for the raiſing and mending of hedges conſiderably different from thoſe above related. For a deer-park he recommends a wall of ſtone coped with turf, having laburnums planted cloſe to it. The heads of the plants are to be lopped off, in order to make the branches extend laterally, and interweave in the form of a hedge. The wall will prevent the deer from breaking through; and if the hedge be trained eight feet high, they will not attempt to leap over. He prefers the laburnum plant, becauſe no beaſt will feed upon it except a hare, and that only when young and the buſh tender. Therefore, no extraordinary care is neceſſary except to preſerve them from the hare for four or five years. A row of alders may be planted in front of the laburnums, which no hare nor any other beaſt will touch. The wall he recommends to be built in the following manner, as being both cheaper and more durable than one conſtructed entirely of ſtone. Raiſe it of ſtone to the height of two feet and a half from the ground, after which it is to be coped with ſod as follows. Firſt, lay on the wall, with the graſſy ſide under, ſod cut with the ſpade four or five inches deep, and of a length equal to the thickneſs of the wall. Next, cover this ſod with looſe earth rounded like a ridge. Third, prepare thin ſod, caſt with the paring ſpade, ſo long as to extend, beyond the thickneſs of the wall, two inches on each ſide. With theſe cover the looſe earth, keeping the graſſy ſide above; place them ſo much on the edge, that each ſod ſhall cover part of another, leaving only about two inches without cover: when 20 or 30 yards are thus finiſhed, let the ſod be beat with mallets by two men, one on each ſide of the wall, ſtriking both at the ſame time. By this operation, the ſod becomes a compact body that keeps in the moiſture, and encourages the graſs to grow. Laſtly, cut off the ragged ends of the ſod on each ſide of the wall, to make the covering neat and regular. The month of October is the proper ſeaſon for this operation, becauſe the ſun and wind, during ſummer, dry the ſod, and hinder the graſs from vegetating. Moiſt ſoil affords the beſt ſod. Wet ſoil is commonly too fat for binding; and, at any rate, the watery plants it produces will not thrive in a dry ſituation. Dry ſoil, on the other hand, being commonly ill bound with roots, ſhakes to pieces in handling. The ordinary way of coping with ſod, which is to lay them flat and ſingle, looks as if intended to dry the ſod and kill the graſs; not to mention that the ſoil is liable to be blown off the wall by every high wind.

683 Fence for a deer-park.

684 Advantages of a thorn hedge.

The advantages of a thorn hedge, according to our author, are, that it is a very quick grower, when planted in a proper ſoil; ſhooting up ſix or ſeven feet in a ſeaſon. Though tender, and apt to be hurt by weeds when young, it turns ſtrong, and may be cut into any ſhape. Even when old, it is more diſpoſed than other trees to lateral ſhoots; and laſtly, its prickles make it the moſt proper of all for a fence. None of theſe thorns ought to be planted in a hedge till five years of age, and it is of the utmoſt importance that they be properly trained in the nurſery. The beſt ſoil for a nurſery, his lordſhip obſerves, is between rich and poor. In the latter the plants are dwarfiſh: in the former, being luxuriant and tender, they are apt to be hurt during the ſeverity of the weather; and theſe imperfections are incapable of any remedy. An eſſential requiſite in a nurſery is free ventilation. "How common (ſays his lordſhip) is it to find nurſeries in hollow ſheltered places, ſurrounded with walls and high plantations, more fit for pine-apples than barren trees! The plants thruſt out long ſhoots, but feeble and tender: when expoſed in a cold ſituation, they decay, and ſometimes die. But there is a reaſon for every thing: the nurſeryman's view is to make profit by ſaving ground, and by impoſing on the purchaſer tall plants, for which he pretends to demand double price. It is ſo difficult to purchaſe wholeſome and well nurſed plants, that every gentleman farmer ought to raiſe plants for himſelf.

685 Of a proper nurſery for raiſing the plants.

686 Of raiſing them from the roots of old hedges.

"As thorns will grow pleaſantly from roots, I have long practiſed a frugal and expeditious method of raiſing them from the wounded roots that muſt be cut off when thorns are to be ſet in a hedge. Theſe roots, cut into ſmall parts, and put in a bed of freſh earth, will produce plants the next ſpring no leſs vigorous than what are produced from ſeed; and thus a perpetual ſucceſſion of plants may be obtained without any more ſeed. It ought to be a rule, never to admit into a hedge plants under five years old; they deſerve all the additional ſum that can be demanded for them. Young and feeble plants in a hedge are of ſlow growth; and, beſides the loſs of time, the paling neceſſary to ſecure

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secure them from cattle must be renewed more than once before they become a fence. A thorn hedge may be planted in every month of winter and spring, unless it be frost. But I have always observed, that thorns planted in October are more healthy, push more vigorously, and fewer decay, than at any other time. In preparing the thorns for planting, the roots ought to be left as entire as possible, and nothing cut away but the ragged parts.

687 Proper method of planting.

"As a thorn hedge suffers greatly by weeds, the ground where they are planted ought to be made perfectly clean. The common method of planting, is to leave eight or nine inches along a side of the intended ditch, termed a *scarsement*; and behind the scarsement to lay the surface soil of the intended ditch, cut into square sods two or three inches deep, its grassy surface under. Upon that sod, whether clean or dirty, the thorns are laid, and the earth of the ditch above them. The grass in the scarsement, with what weeds are in the moved earth, soon grow up, and require double diligence to prevent the young thorns from being choked. The following method deserves all the additional trouble it requires. Leaving a scarsement as above of 10 inches, and also a border for the thorns, broad or narrow according to their size; lay behind the border all the surface of the intended ditch, champed small with the spade, and upon it lay the mouldery earth that fell from the spade in cutting the said surface. Cover the scarsement and border with the under earth, three inches thick at least; laying a little more on the border to raise it higher than the scarsement, in order to give room for weeding. After the thorns are prepared by smoothing their ragged roots with a knife, and lopping off their heads to make them grow bushy, they are laid fronting the ditch, with their roots on the border, the head a little higher than the root. Care must be taken to spread the roots among the surface-earth taken out of the ditch, and to cover them with the mouldery earth that lay immediately below. This article is of importance, because the mouldery earth is the finest of all. Cover the stems of the thorns with the next stratum of the ditch, leaving always an inch at the top free. It is no matter how poor this stratum be, as the plants draw no nourishment from it. Go on to finish the ditch, pressing down carefully every row of earth thrown up behind the hedge, which makes a good solid mound impervious to rain. It is a safeguard to the young hedge to raise this mound as perpendicular as possible; and for that reason, it may be proper, in loose soil, when the mound is raised a foot or so, to bind it with a row of the tough sod, which will support the earth above till it become solid by lying. In poor soil more care is necessary. Behind the line of the ditch the ground intended for the scarsement and border should be summer fallowed, manured, and cleared of all grass roots; and this culture will make up for the inferiority of the soil. In very poor soil, it is vain to think of planting a thorn hedge. In such ground there is a necessity for a stone fence.

"The only reason that can be given for laying thorns as above described, is to give the roots space to push in all directions; even upward into the mound of earth. There may be some advantages in this; but, in my apprehension, the disadvantage is much greater of heaping so much earth upon the roots as to exclude not only the sun, but the rain which runs down the sloping bank, and has no access to the roots. Instead of laying the thorns fronting the ditch, would it not do better to lay them parallel to it; covering the roots with three or four inches of the best earth, which would make a hollow between the plants and the sloping bank? This hollow would intercept every drop of rain that falls on the bank, to sink gradually among the roots. Why, at any rate, should a thorn be put into the ground sloping? This is not the practice with regard to any other tree; and I have heard of no experiment to persuade me that a thorn thrives better sloping than erect. There occurs, indeed, one objection against planting thorns erect, that the roots have no room to extend themselves on that side where the ditch is. But does it not hold, that when, in their progress, roots meet with a ditch, they do not push onward; but, changing their direction, push downward at the side of the ditch? If so, these downward roots will support the ditch, and prevent it from being mouldered down by frost. One thing is evident without experiment, that thorns planted erect may sooner be made a complete fence than when laid sloping as usual. In the latter case, the operator is confined to thorns that do not exceed a foot or 15 inches; but thorns five or six feet high may be planted erect; and a hedge of such thorns, well cultivated in the nursery, will in three years arrive to greater perfection than a hedge managed in the ordinary way will do in twice that time."

688 Of securing a hedge after it is planted.

After the hedge is finished, it is absolutely necessary to secure it for some time from the depredations of cattle; and this is by no means an easy matter. "The ordinary method of a paling (says his lordship) is no sufficient defence against cattle: the most gentle make it a rubbing post, and the vicious wantonly break it down with their horns. The only effectual remedy is expensive; viz. two ditches and two hedges, with a mound of earth between them. If this remedy, however, be not palatable, the paling ought at least to be of the strongest kind. I recommend the following as the best I am acquainted with: Drive into the ground strong stakes three feet and a half long, with intervals from eight to twelve inches, according to the size of the cattle that are to be inclosed; and all precisely of the same height. Prepare plates of wood sawed out of logs, every plate three inches broad and half an inch thick. Fix them on the head of the stakes with a nail driven down into each. The stakes will be united so firmly, that one cannot be moved without the whole; and will be proof accordingly against the rubbing of cattle. But, after all, it is no fence against vicious cattle. The only proper place for it is the side of a high road, or to fence a plantation of trees. It will indeed be a sufficient fence against sheep, and endure till the hedge itself becomes a fence. A fence thus completed, including thorns, ditching, wood, nails, &c. will not much exceed two shillings every six yards."

689 Of training up hedges.

His lordship discommends the ordinary method of training hedges by cutting off the top and shortening the lateral branches in order to make it thick and bushy. This, as well as the method of cutting off the stems two or three inches above the ground, indeed produces

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produces a great number of shoots, and makes a very thick fence, but which becomes so weak when bare of leaves, that cattle break through it in every part. To determine the best method of proceeding in this case, his lordship made an experiment on three hedges, which were twelve years old at the time he wrote. The first was annually pruned at the top and sides; the sides of the second were pruned, but not the top; and the third was allowed to grow without any pruning. The first, at the time of writing, was about four feet broad, and thick from top to bottom; but weak in the stems, and unable to resist any horned beast: the second was strong in its stems, and close from top to bottom: the third was also strong in its stems, but bare of branches for two feet from the ground; the lower ones having been deprived of air and rain by the thick shade of those above them. Hence he directs that hedges should be allowed to grow till the stems be five or six inches in circumference, which will be in ten or twelve years; at which time the hedge will be fifteen feet or more in height. The lateral branches next the ground must be pruned within two feet of the stem; those above must be made shorter and shorter in proportion to their distance from the ground; and at five feet high they must be cut close to the stem, leaving all above full freedom of growth. By this dressing the hedge takes on the appearance of a very steep roof; and it ought to be kept in that form by pruning. This form gives free access to rain, sun, and air: every twig has its share, and the whole is preserved in vigour. When the stems have arrived at their proper bulk, cut them over at five feet from the ground, where the lateral branches end. This answers two excellent purposes: the first is to strengthen the hedge, the sap that formerly ascended to the top being now distributed to the branches; the next is, that a tall hedge stagnates the air, and poisons both corn and grass near it. A hedge trained in this manner is impenetrable even by a bull.

690 Plashing of hedges discommended.

With regard to the practice of *plashing* an old hedge recommended by Dr Anderson, his lordship observes that "it makes a good interim fence, but at the long run is destructive to the plants; and accordingly there is scarcely to be met with a complete good hedge where plashing has been long practised. A thorn is a tree of long life. If, instead of being massacred by plashing, it were raised and dressed in the way here described, it would continue a firm hedge perhaps 500 years.

691 Hedges ought to be planted on the side of the bank, and no trees allowed in them.

"A hedge ought never to be planted on the top of the mound of earth thrown up from the ditch. It has indeed the advantage of an awful situation; but being planted in bad soil, and destitute of moisture, it cannot thrive: it is at best dwarfish, and frequently decays and dies. To plant trees in the line of the hedge, or within a few feet of it, ought to be absolutely prohibited as a pernicious practice. It is amazing that people should fall into this error, when they ought to know that there never was a good thorn hedge with trees in it. And how should it be otherwise? An oak, a beech, an elm, grows faster than a thorn. When suffered to grow in the midst of a thorn hedge, it spreads its roots everywhere, and robs the thorns of their nourishment. Nor is this all: the tree, overshadowing the thorns, keeps the sun and air from them. At the same time, no tree takes worse with being overshadowed than a thorn.

692 Of filling up gaps.

"It is scarce necessary to mention gaps in a hedge, because they will seldom happen where a hedge is trained as above recommended. But in the ordinary method of training, gaps are frequent, partly by the failure of plants, and partly by the trespassing of cattle. The ordinary method of filling up gaps is to plant sweet briar where the gap is small, and a crab where it is large. This method I cannot approve for an obvious reason: a hedge ought never to be composed of plants which grow unequally. Those that grow fast, overtop and hurt the slow growers; and with respect, in particular, to a crab and sweet briar, neither of them thrive under the shade. It is a better method to remove all the withered earth in the gap, and to substitute fresh sappy mould mixed with some lime or dung. Plant upon it a vigorous thorn of equal height with the hedge, which in its growth will equal the thorns it is mixed with. In that view there should be a nursery of thorns of all sizes, even to five feet high, ready to fill up gaps. The best season for this operation is the month of October. A gap filled with sweet briar, or a crab lower than the hedge, invites the cattle to break through and trample the young plants under foot; to prevent which, a paling raised on both sides is not sufficient, unless it be raised as high as the hedge.

693 In what cases whins are necessary.

"Where a field is too poor to admit of a thorn hedge, if there be no quantity of stones easily procurable, whins are the only resource. These are commonly placed on the top of a dry earth dyke, in which situation they seldom thrive well. The following seems preferable. Two parallel ditches three feet wide and two deep, border a space of twelve feet. Within this space raise a bank at the side of each ditch with the earth that comes out of it, leaving an interval between the two banks. Sow the banks with whin seed, and plant a row of trees in the interval. When the whins are pretty well grown, the hedge on one of the banks may be cut down, then the other as soon as it becomes a fence, and so on alternately. While the whins are young, they will not be disturbed by cattle, if passages be left to go out and in. These passages may be closed up when the hedge is sufficiently strong to be a fence. A whin hedge thus managed, will last many years, even in strong frost, unless very severe. There are many whin hedges in the shire of Kincardine not so skilfully managed, and yet the possessors appear not to be afraid of frost. Such fences ought to be extremely welcome in the sandy grounds of the shire of Moray, where there is scarce a stone to be found. The few earth fences that are there raised, composed mostly of sand, very soon crumble down."

In the fourth volume of Mr Young's Northern Tour, the author recommends the transplanting of old hedges, which his correspondent Mr Beverly says he has tried with prodigious success.

Annals of Agriculture, vol. vi. p. 357. ib. p. 494.

694 Mr Bakewell's fences.

Mr Bakewell, we are told, is very curious in his fences, and plants his quicks in a different manner from what is common in various parts of the kingdom. He plants one row at a foot from set to set, and making his ditch, lays the earth which comes out of it to form a bank on the side opposite to the quick. In the common method, the bank is made on the quick side above it. Reasons are not wanting to induce a preference of this

Fences. this method. The plants grow only in the ſurface the earth uncovered from the atmoſphere, which muſt neceſſarily be a great advantage; whereas, in the uſual way of planting, that earth, which is always the beſt, is loaded by a thick covering obliquely of the earth out of the ditch. If the roots ſhoot in the beſt ſoil, they will be out of the reach of the influences of the air; the conſequence of which is, that they cannot have ſo large a ſpace of that earth as if ſet on the flat. The way to have a tree or a quick thrive in the beſt manner poſſible, is to ſet it on the ſurface without any ditch or trench, that cuts off half its paſture. But if a ditch is neceſſary, the next beſt way muſt of courſe be ſtill to keep it on the flat ſurface; and the worſt way to cover up that ſurface, by loading it with the dead earth out of a trench. To ſay that there are good hedges in the common method is not a concluſive argument, unleſs both were tried on the ſame ſoil and expoſure.

695 Of hedges in ſtony and gravelly ſoils.

In the 7th volume of the ſame work, a correſpondent, who ſigns himſelf M. M. obſerves, that notwithſtanding all the improvements that have been made in the conſtruction of hedges and fences, there are many ſoils in England, which, from their ſandy and gravelly natures, are little adapted to any of the plants in common uſe, and are therefore ſubject to all the inconveniences of dead hedges and gaps. Of this kind are all the ſandy and gravelly incloſures, which conſtitute ſo large a part of many diſtricts in the iſland. For theſe our author recommends a triple row of furze; though, notwithſtanding its advantages, he ſays it is liable to be deſtroyed by ſevere winters, contrary to the aſſertion of Lord Kames above related. "It is liable (ſays he) to be ſo completely cut off by a ſevere winter, that I have ſeen tracts of many hundred acres laid open in the ſpace of a few weeks, and reduced to as defenceleſs a ſtate as the ſurrounding waſtes. On ſuch ſoils therefore he recommends the holly; the only diſadvantage of which, he ſays, is its ſlow growth. On moſt of theſe ſoils alſo the black thorn will riſe ſpontaneouſly; and even the quick, though ſlowly, will advance to a ſufficient degree of perfection. The birch, however, he particularly recommends, as growing equally on the drieſt and on the wetteſt ſoils, propagating itſelf in ſuch numbers, that, were they not deſtroyed, all the ſandy waſtes of this kingdom would be quickly covered with them. He recommends particularly the keeping of a nurſery for ſuch plants as

696 Of a proper nurſery.

are commonly uſed for hedges. "I generally (ſays he) pick out a bit of barren land, and after ploughing it three or four times to bury and deſtroy the heath, I find it anſwer extremely well for a nurſery. Into this ſpot I tranſplant quick, hollies, and every tree which I uſe for fences or plantations. By eſtabliſhing ſuch a nurſery, a gentleman will always be able to command a ſufficiency of ſtrong and hardy plants which will not deceive his expectations. I look upon thorns of five or ſix years old, which have been twice tranſplanted from the ſeed-bed, to be the beſt of all; but as it may be neceſſary to fill up caſual gaps in hedges that have been planted ſeveral years, a proviſion ſhould be made of plants of every age, to twelve or fourteen years old. All plants which are intended to be moved, ſhould be tranſplanted every two, or at moſt three years; without this attention, they attach themſelves ſo firmly to the ſoil as renders a ſubſequent operation dangerous. All who tranſplant quicks or hollies ought to begin their labours as early as convenient in the autumn; for I have found, by repeated experience, that neither of theſe plants ſucceed ſo well in the ſpring."

697 Of repairing ruinous hedges.

Where the fences of a tract of ground are in a very ruinous condition, it is abſolutely neceſſary to ſcour the ditches, throw up the banks, and ſecure the whole immediately by the firmeſt dead fences we can procure. If there is a total want of living plants, the cultivator can do nothing but plant new hedges; but if, as is generally the caſe, the banks are furniſhed with a multitude of old ſtems, though totally unconnected as a fence, the time and labour requiſite for the intended improvement will be conſiderably abridged. All the ſtraggling branches which add no ſolidity to the fence are to be cut off; after which the reſt of the ſtems muſt be ſhortened to the height of three or four feet. The method of cutting down every thing to the ground, which is now ſo general, our author highly condemns. "Such a fence (ſays he) has within it no principle of ſtrength and connection; it is equally expoſed in every part to depredations of cattle and ſportſmen; and even ſhould it eſcape theſe, the firſt fall of ſnow will nearly demoliſh it. On the contrary, wherever theſe vegetable paliſades can be left, they are impenetrable either for man or horſe, and form ſo many points of union which ſupport the reſt."

Another method of ſtrengthening defective fences is, to bend down ſome of the lateral ſhoots in a horizontal direction, and to ſpread them along the line of the farm, like eſpalier trees in a garden. A ſingle ſtem, when it riſes perpendicularly, will not ſecure a ſpace of more than two or three feet, but when bent longitudinally, it will form a barrier at leaſt ſufficient to repel all cattle but hogs for twelve or fourteen on one

698 Plaſhing of hedges diſcommended.

ſide. By bending down, our author does not mean the common *plaſhing* method, which is very injurious to the plants; but the ſpreading two or three of the moſt convenient branches along the hedge, and faſtening them down either by pegs or tying, without injury to the ſtem, until they habitually take the propoſed direction. Thoſe who make the experiment for the firſt time will be aſtoniſhed how ſmall a number of plants may be made to fill a bank, with only trifling intervals. The birch is particularly uſeful for this purpoſe; being of ſo flexible a nature, that ſhoots of ten or twelve feet in length may be eaſily forced into a horizontal direction; and if the other ſhoots are pruned away, all the juices of the plant will be applied to nouriſh the ſelected few: by which means they will in a few years acquire all the advantages of poſts and rails, with this material difference, that inſtead of decaying, they become annually better. It is beſides the property of all inclined branches to ſend up a multitude of perpendicular ſhoots; ſo that by this horizontal inclination, if judiciouſly made, you may acquire almoſt all the advantages of the thickeſt fence; but when the ſtems are too old and brittle to bear this operation, it will be adviſable to cut off all the uſeleſs ones cloſe to the ground, and next ſpring they will be ſucceeded by a number of young and vigorous ones. Select the beſt of theſe to be trained in the manner already directed, and extirpate all the reſt, to increaſe their

Fences. their vigour. The ſhoots of ſuch old ſtems as have been juſt now deſcribed will attain a greater ſize in three or four years than any young ones that can be planted will do in twelve.

699 Of thickening hedges by laying down the young ſhoots.

Another method which our author has practiſed with the greateſt ſucceſs is the following. The tender ſhoots of moſt trees, if bended downwards and covered with earth, will put forth roots, and being divided from the parent ſtem at a proper time, become freſh plants; an operation well known to gardeners, under the name of *laying*. This may be as advantageous to the farmer, if he will take the very moderate trouble of laying down the young and flexible branches in his fences. Moſt ſpecies of trees, probably all, will be propagated by this method; but particularly the withy, the birch, the holly, the white thorn, and the crab, will alſo take root in this method, though more ſlowly; the latter being an excellent plant for fences, and not at all nice in the ſoil on which it grows. The advantage of laying down branches in this manner over the planting of young ones is, that when you endeavour to fill up a gap by the latter method, they advance very ſlowly, and are in danger of being ſtifled by the ſhade of the large trees; whereas, if you fortify a gap by ſpreading the branches along it in the manner juſt mentioned, and at the ſame time inſert ſome of the moſt thriving ſhoots in the ground, they will advance with all the vigour of the parent plant, and you may allow them to grow until they are ſo fully rooted as to be free from danger of ſuffocation.

700 In what caſe the cutting down of hedges is proper.

It frequently happens, that the fences of an eſtate have been neglected for many years, and exhibit nothing but ragged and deformed ſtems at great intervals. In this caſe it will be proper to cut them all off level with the ground: the conſequence of this is, that next year they will put forth a great number of ſhoots, which may be laid down in every direction, and trained for the improvement of the fence. When this operation is performed, however, it ought always to be done with an axe, and not with a ſaw; it being found that the latter inſtrument generally prevents the vegetation of the plant. All the ſhoots laid down in this manner ſhould be allowed to remain for ſeveral years, that they may be firmly rooted. Thus they will make prodigious advances; and it is to be obſerved, that the more the parent plant is diveſted of all ſuperfluous branches, the greater will be the nouriſhment tranſmitted to the ſcions.

Our author, however, is inclined to ſuſpect that the moſt perfect form of a hedge, at leaſt in all but thoſe compoſed of thorns and prickly plants, is to train up as many ſtems as will nearly touch each other. The force of every fence conſiſts chiefly in the upright ſtems: where theſe are ſufficiently near and ſtrong, the hedge reſiſts all oppoſition, and will equally repel the violence of the bull, and the inſidious attacks of the hogs. It is abſolutely proper that all hedges ſhould be inſpected once a-year; when not only the ditch ought to be thrown out, and the bank ſupported, but the ſtraggling ſhoots of all the live plants ought to be pruned. By theſe are meant all ſuch as project over the ditch beyond the line of the hedge, and which add nothing to its ſtrength, though they deprive the uſeful ſtems of part of their nouriſhment. Where a hedge is compoſed of plants of inferior value, it will be proper to train thoſe in the manner juſt now recommended, and to plant the bank with quick or holly. When theſe laſt have attained a ſufficient ſize, the others may be extirpated; which is beſt done by cutting down all the ſhoots repeatedly in the ſummer, and leaving the roots to rot in the hedge. Fences.

701 Mr Erſkine's method of conſtructing hedges.

In the 13th volume of the Annals, W. Erſkine, Eſq. gives an account of a method of fencing very much reſembling that recommended by Lord Kames, and which has been already deſcribed. That gentleman is of opinion, that, in ſome caſes *dead ſtone walls*, as they are called, are more advantageous than hedges. "That hedges (ſays he) are more ornamental, cannot be denied; and they are generally allowed to afford more ſhelter: but the length of time, the conſtant attention, and continual expence of defending them until they bear even the reſemblance of a fence, induces many people in thoſe places where the materials are eaſily procured, to prefer the dry ſtone walls; for though the firſt coſt is conſiderable, yet as the farmer reaps the immediate benefit of the fence (which is undoubtedly the moſt ſecure one), they are thought on the whole to be the leaſt expenſive; beſides, the cattle in expoſed ſituations, and eſpecially in theſe northern parts, are ſo impatient of confinement at the commencement of the long, cold, wet nights, that no hedges I have ever yet ſeen, in any part of this iſland, are ſufficient to keep them in."

From conſiderations of this kind, the late Sir George Suttie of Eaſt Lothian was induced to think of a fence which might join the ſtrength of the wall to the ornament of the hedge. His thorns were planted in the uſual manner on the ſide of the ditch: but inſtead of putting behind them a poſt and rail or paling on the top of the bank, he erected a wall two feet and a half high; and being well ſituated for procuring lime, he uſed it in the conſtruction of theſe walls which Mr Erſkine greatly recommends; "as the ſatisfaction they afford, by requiring no repairs, and the duration of them, more than repay the expence: but where the price of lime is high they may be built without any cement, and anſwer the purpoſe very well if the work is properly executed."

In making a new fence of this kind, the ſurface of the ground ſhould be pared off the breadth of the ditch, and likewiſe for two feet more, in order to prevent as much as poſſible the thorns from being injured by the growth of graſs and weeds. The ditch ſhould be five feet broad, two and a half in depth, and one foot broad at the bottom. Leave one foot for an edging or ſcarſement, then dig the earth one ſpit of a ſpade for about one foot, and put about three inches of good earth below the thorn, which ſhould be laid nearly horizontal, but the point rather inclining upwards, in order to let the rain drip to the roots; then add a foot of good earth above it: leave three or four inches of a ſcarſement before another thorn is planted; it muſt not be directly over the lower one, but about nine inches or a foot to one ſide of it: then throw a foot of good earth on the thorn, and trample it well down, and level the top of the bank for about three feet and a half for the baſe of the wall to reſt on. This baſe ſhould be about nine or ten inches, but muſt not exceed

Fences. exceed one foot from the thorn. The wall ought to be about two feet thick at the bottom and one foot at the top: the cope to be a ſingle ſtone laid flat; then covered with two ſods of turf, the graſs of the undermoſt to be next the wall, and the other ſod muſt have the graſs ſide uppermoſt. The ſods ſhould be of ſome thickneſs, in order to retain moiſture; ſo that they may adhere together, and not be eaſily diſplaced by the wind. The height of the wall to be two feet and a half, excluſive of the ſods; which together ſhould be from four to ſix inches, by which means the wall would be near to three feet altogether. The expence of the fences cannot ſo eaſily be counted, on account of the difference of the prices of labour in different parts. Mr Erſkine had them done with lime, every thing included, from 10½ to 13d. *per* ell (which is equal to 37 inches 2 parts), according to the eaſe or difficulty of working the quarry, and the diſtance of it from the place where the fence is erected. The lime coſts about 6d. *per* boll of about 4.0872667 buſhels; and from 15 to 16 bolls of lime are uſed to the rood of 36 ſquare ells Scots meaſure; and there are upwards of 43 Scots ells, or 44 Engliſh yards. When the common round or flint ſtones are made uſe of, as they require more lime, it is neceſſary to uſe 30 or 35 bolls of lime to the rood. The thorns are ſold from five to ten ſhillings *per* thouſand, according to their age, reckoning ſix ſcore to the hundred. Making the ditch, laying the thorns, and preparing the top of the wall, generally coſt from 7d. to 8d. every ſix ells. About 50 carts of ſtones, each cart carrying from ſeven to nine cwt. will build a rood; the carriage at 2d. *per* cart for half a mile's diſtance.

Warmth is undoubtedly extremely beneficial to hedges; and the walls give an effectual ſhelter, which in expoſed ſituations is abſolutely neceſſary for rearing young hedges; and they likewiſe preſerve a proper degree of moiſture about the roots. If the hedges have been planted for ſix or ſeven years before the wall is built, cut them over to two or three inches above the ground with a ſharp tool, either in October or November, or early in the ſpring; and erect the wall as quickly in that ſeaſon as poſſible (the ſpring in this country can ſcarcely be ſaid to begin till the end of March). It is almoſt impoſſible to imagine the rapidity with which hedges grow in favourable ſituations. Mr Erſkine had one cut over in the ſpring, and by the end of the year it was almoſt as high as the wall. In three years he ſuppoſed, that not even the Highland ſheep, who eaſily overleap a wall of four feet and a half in height, would have been able to break through it.

702 Reaſons for planting oak trees in hedges.

Notwithſtanding the reaſons that have been given already againſt the planting of timber trees in hedges, we find the practice recommended by ſome authors as one of the beſt ſituations for raiſing ſhip-timber. The reaſons are, that the roots have free range in the adjoining incloſures, and the top is expoſed to the exerciſe of the winds; by which means the trees are at once enabled to throw out ſtrong arms, and have a large ſpreading head at the ſame time; ſo that we thus at once obtain quickneſs of growth with ſtrength and crookedneſs of timber. Well trained timber trees it is alleged are not prejudicial to hedges, though pollards and low ſpreading trees are deſtructive to the hedge-wood which grows under them; neither are high trees prejudicial to corn-fields like high hedges and pollards, which prevent a proper circulation of air; and in Norfolk, where the cultivation of grain is carried on in great perfection; ſuch lands are ſaid to be *wood-bound*. But when a hedge is trimmed down to four or five feet high, with oaks interſperſed, a circulation of air is rather promoted than retarded by it: and a trimmed hedge will thrive quite well under tall ſtemmed trees, particularly oaks. For arable incloſures, therefore, hedges are recommended of four or five feet high, with oak-timbers from 15 to 25 feet ſtem. Higher hedges are more eligible for graſs-lands: the graſſes affect warmth, by which their growth is promoted, and conſequently their quantity is increaſed, though perhaps their quality may ſuffer ſome injury. A tall fence likewiſe affords ſhelter to cattle, provided it be thick and cloſe at the bottom; but otherwiſe, by admitting the air in currents, it does rather harm than good. The ſhade of trees is equally friendly to cattle in ſummer: for which reaſon it is recommended in graſs incloſures to allow the hedge to make its natural ſhoots, and at the ſame time to have oak-trees planted in it at proper intervals. Upon bleak hills, and in expoſed ſituations, it will be proper to have two or even three rows of hedge-wood, about four feet diſtant from each other; the middle row being permitted to reach, and always to remain at, its natural height: whilſt the ſide rows are cut down alternately to give perpetual ſecurity to the bottom, and afford a conſtant ſupply of materials for dead hedges and other purpoſes of underwood.

703 Beſt method of planting and raiſing holly for hedges.

Much has been ſaid of the excellency of the holly as a material for hedges; and indeed the beauty of the plant, with its extreme cloſeneſs, and continuing green throughout the winter, evidently give it the preference to all others; and could it be raiſed with equal eaſe, there is no doubt that it would come into univerſal practice. Beſides the above properties, the holly will thrive almoſt upon any ſoil; but thin-ſoiled ſtony heights ſeem to be its natural ſituation; and it may properly enough be ſaid, that holly will grow wherever corn will. Its longevity is likewiſe exceſſive; and being of ſlow growth, it does not *ſuck the land*, as the farmers expreſs it, or deprive the crop of its nouriſhment, as other hedges do. The difficulty of raiſing holly may be obviated by planting it under crabs, which have a tendency to grow more upright than hawthorns, and conſequently affording more air, will not impede its progreſs though they afford ſhelter. It may even be raiſed alone without any great difficulty; only in this caſe the dead fence, to ſecure it, muſt be kept up at leaſt ten or twelve years, inſtead of ſix or ſeven, as in the other caſe; and indeed, conſidering the advantages to be derived from fences of this kind, they ſeem to merit all the additional trouble requiſite.

The holly may be raiſed either under the crab or hawthorn in two ways, viz. by ſowing the berries when the quick is planted, or by inſerting the plants themſelves the enſuing midſummer. The former is by much the more ſimple, and perhaps upon the whole the better method. The ſeeds may either be ſcattered among the roots of the deciduous plants, or be ſown in a drill in front: and if plants of holly be

Fences.

be put in, they may either be planted between those of the crab, or otherwise in front in the quincunx manner.

704
Hedges of whins or furze.

"Whins (furze) have been often employed, says Dr Anderson, as a fence when sown upon the top of a bank. They are attended with the convenience of coming very quickly to their perfection, and of growing upon a soil on which few other plants could be made to thrive; but in the way that they are commonly employed, they are neither a strong nor a lasting fence. The first of these defects may, in some measure, be removed, by making the bank upon which they are sowed (for they never should be transplanted) of a considerable breadth; in order that the largeness of the aggregate body, considered as one mass, may, in some measure, make up for the want of strength in each individual plant. With this view, a bank may be raised of five or six feet in breadth at the top, with a large ditch on each side of it; raising the bank as high as the earth taken from the ditches will permit; the surface of which should be sowed pretty thick with whin seeds. These will come up very quickly: and in two or three years will form a barrier that few animals will attempt to break through, and will continue in that state of perfection for some years. But the greatest objection to this plant as a fence is, that, as it advances in size, the old prickles always die away; there being never more of these alive at any time upon the plant, than those that have been the produce of the year immediately preceding: and these thus gradually falling away, leave the stems naked below as they advance in height; so that it very soon becomes an exceeding poor and unsightly fence; the stems being entirely bare, and so slender withal as not to be able to make a sufficient resistance to almost any animal whatever. To remedy this great defect, either of the two following methods may be adopted. The first is to take care to keep the bank always stored with young plants; never allowing them to grow to such a height as to become bare below: and it was principally to admit of this, without losing at any time the use of the fence, that I have advised the bank to be made of such an unusual breadth. For if one side of the hedge be cut quite close to the bank, when it is only two or three years old, the other half will remain as a fence till that side become strong again; and then the opposite side may be cut down in its turn; and so on alternately as long as you may incline: by which means the bank will always have a strong hedge upon it without ever becoming naked at the root. And as this plant, when bruised, is one of the most valuable kinds of winter food yet known for all kinds of domestic animals, the young tops may be carried home and employed for that purpose by the farmer; which will abundantly compensate for the trouble of cutting, and the waste of ground that is occasioned by the breadth of the bank.

"The other method of preserving a hedge of whins from turning open below, can only be practised where sheep are kept; but may be there employed with great propriety. In this case it will be proper to sow the seeds upon a conical bank of earth, shoved up from the surface of the ground on each side without any ditches. If this is preserved from the sheep for two or three years at first, they may then be allowed free access to it; and, as they can get up close to the foot of the bank upon each side, if they have been accustomed to this kind of food, they will eat up all the young shoots that are within their reach, which will occasion them to send out a great many lateral shoots: and these being continually browsed upon, soon become as close as could be desired, and are then in no sort of danger of becoming naked at the root, although the middle part should advance to a considerable height.

Where furze or whins are to be used either as a fence by themselves, or in assistance to another, it is perhaps more proper to use the French seed than that produced in Great Britain, as the former seldom ripens in this country, and consequently cannot like the latter overrun the adjacent inclosure. It may be had at the seed-shops in London for about 15d. per pound, and one pound will sow 40 statute roods. When used as an assistant to a hedge, it is more proper to sow it on the back of the bank than on the top of it; as in this case it is more apt to overhang the young plants in the face of the bank; whilst in the other it is better situated for guarding the bank, and preventing it from being torn down by cattle. The method of sowing is as follows: Chop a drill with a sharp spade about two-thirds of the way up the back of the bank, making the cleft gape as wide as may be without breaking off the lip; and having the seed in a quart bottle, stopped with a cork and goose quill, or with a perforated wooden stopper, trickle it along the drill, covering it by means of a broom drawn gently above and over the mouth of the drill. Closing the drill with the back of the spade, shuts up the seeds too much from the air, and thus keeps them too long from rising.

705
Gooseberry hedge.

We do not know that any person has yet attempted to make use of the gooseberry for the purpose of making hedges, though few plants seem better adapted for that purpose. It grows readily. Some varieties of it rise to a considerable height, and by the strength and number of its prickles, it would effectually prevent any animal from breaking through.—It is said that some species of the mulberry not only grow and thrive in England, but are capable of being reared to perfection in Scotland, as has been experienced at Dalkeith. As the leaves of this plant are the food of the silk-worm, which produces the most beautiful and valuable of all the materials that can occupy the loom, it is perhaps worthy of attention how far it might be worth while to rear it as a fence in hedge-rows with a view to its becoming the basis of a valuable manufacture.

706
Fences of stone walls.

Dry stone walls are sometimes erected of those round and apparently water-worn stones which the plough throws out, and which may be gathered in every field. They are usually coped with sod. This, however, is a very indifferent fence. In most instances it is erected by common labourers, and is therefore ill constructed, so as not even to be of an uniform thickness from top to bottom. The round figure of the stones also prevents the building from being well bound together. Even the cattle rubbing themselves against it are apt to make considerable gaps, which render constant attention necessary to keep it in repair. It is cheaply executed, however, and affords the means of at once fencing the land and clearing it of stones. When dry stone walls are skilfully built by

Fences. by mafons, and made with quarried ftones finifhed with a good coping, they look well and laft for many years; but the coping ought to be of ftone and not of turf or mud.

To render ftone and lime walls valuable as fences, they fhould have a broad bafe, and have a foundation fufficiently deep to prevent their being injured by the loofening of the foil which is produced by froft. This fence is very durable, but it is alfo very expenfive. To be in perfection, it ought to be executed not with common ftones gathered from the fields, but with ftones from the quarry: It ought to be fecured at the top with a coping of ftone of the flag kind laid together in fuch a way as to render the wall narrow at top like the roof of a houfe. If the coping is neglected, the moifture foon finds its way into the heart of the wall, and it is alfo liable to various accidents from idle perfons climbing over it.

707 The Galloway dike. The Galloway dike owes its name to the county in which it was firft ufed. It confifts of a broad building of dry ftones tapering upwards. Large flat ftones are then laid on like a coping, and project over the wall on each fide. Above thefe ftones large rugged round ftones are laid, and fmaller ftones above thefe, fo as to admit a free paffage to the winds which whiftle through them. The Galloway dike is never raifed very high, but its tottering appearance fo terrifies the cattle and fheep, that they dare not touch it; fo that it is a very effectual fence, though it neither affords fhelter nor ornament to the country. It has the advantage, however, of being erected at a very trifling expence; it is not unfuitable to thofe lower parts of the country in which the fhelter of high trees and hedges would prove pernicious to the corn crop, and where the confinement of the ftock is all that is required.

Clay is fometimes ufed inftead of lime for binding ftone walls; but it is a very defective cement; for if froft fuddenly fucceed to wet weather it is apt to fwell and to tumble down at the next thaw. To guard againft the effects of moifture, thefe ftone and clay walls are fometimes rough-caft or coated over with lime. If the coating is very thick and the wall properly coped, it may laft in this way as long as a wall of ftone and lime.

For the fake of the appearance, dry-ftone walls have fometimes two or three inches at the top of them on each fide lipped or wafhed with lime, which adds nothing to their ftrength, but gives them the appearance of being built entirely with ftone and lime. With the fame view, and with the fame effect, they are fometimes alfo broad-caft or coated with lime over their whole furface. Dry-ftone walls, after they are finifhed are fometimes pinned and harled, or rough-caft, that is, the mafon fills up all the interftices of the building with fmall ftones, and afterwards coats it over with lime, which adds confiderably to its durability.

Low dry-ftone walls have fometimes a light paling at the top, which gives them a handfome appearance.

Brick walls are fometimes ufed where ftones are extremely fcarce, but they are chiefly employed for facing garden walls.

708 Frame walls. Frame walls are conftructed in the following manner. A frame of boards of the width and heighth intended for the future wall is placed upon the line that has been dug for a foundation. The frame is filled to the top with ftones gathered from the adjoining fields, and a quantity of liquid mortar is poured in amongft them fufficient to fill up every interftice. The whole is allowed to remain for a day or two, or longer, till the building is dried fo far as to have acquired fome ftability. The frame is then removed, and placed a little farther on in the fame line, but in contact with the laft-made piece of wall, and the operation is renewed. This is fuppofed to have been a very ancient mode of building.

Turf walls are found very ufeful in upland diftricts for temporary purpofes, fuch as for folds, or for protecting young plantations or young hedges. Their ftrength is fometimes increafed, without augmenting the expence of the conftruction, by intermingling them with ftones, that is, by forming the wall of alternate layers of turf and ftone.

Mud walls with a mixture of ftraw, are very frequent in many places both of England and Scotland, and they are ufed not only for fences, but alfo for conftructing the walls of farm houfes and offices, in the poorer parts of the country. They are formed in the following manner. Straw and clay are incorporated with each other, like hair with plaifter lime, and formed into large pieces. A ftratum of thefe is laid at the bottom of the intended wall. The different pieces are then firmly kneaded with the hand, and preffed at each fide with a flat board, which not only confolidates, but gives fmoothnefs and uniformity to the work. Succeffive ftrata are added till the wall is reared to its intended height. If walls thus conftructed are properly coated with lime, to protect them againft moifture, they become very durable; and their appearance is not inferior to that of a ftone and lime building. 709 Mud walls.

Of compound fences, the moft ordinary is the fingle hedge and ditch, with or without paling. The mode of planting thefe hedges has been already ftated on the authority of Lord Kames and others; and we fhall only add, that if a hedge is wifhed to rife with rapidity, the fpot in which it is planted ought to be enriched with lime, compoft, or other manures, as hedge plants cannot, any more than other plants, fpring rapidly without cultivation. Where a hedge is planted at the top of a ditch, it may alfo be remarked, that it is doubly neceffary to give the ditch a proper degree of flope, that it may not be undermined by any accident, which would have the effect to lay bare the roots of the hedge, or entirely to bring it down. Where it is wifhed to render lands inclofed with hedge and ditch fencible at once, a kind of Galloway dike, confifting of fome rows of large coarfe loofe ftones, may be placed upon the top of the bank, which will have the effect of protecting the hedge againft cattle. 710 Compound fences.

The double ditch with a hedge in the front of each, is now practifed, particularly on cold lands, in many parts of Great Britain. It may be remarked, that where thefe double ditches are wanted for drains, it is undoubtedly a proper practice; but in other fituations it is exceptionable, as laying out unprofitably a large portion of the foil.

When a hedge and ditch is ufed, whether fingle or double, the hedge is fometimes placed not at the bottom of the bank, which is the ufual way, but in the middle of it, at fome height above the ordinary furface of the field. In fuch a mode of planting, the hedge is

Fences.

expoſed to great injury from the bank mouldering down, and from want of proper nouriſhment; but the practice is ſometimes neceſſary upon wet lands, where hedges would not thrive, if placed upon the common ſurface. Sometimes the face of a natural declivity is cut down, in a ſloping direction, to within 18 or 20 inches of the bottom. Here a bed is made and covered with good earth, in which the plants are inſerted. A hedge planted in this way looks formidable, from the ſide facing the bank; but it is expoſed to more accidents, from a failure of its ſoil in conſequence of froſts, than if planted at the bottom of the bank.

711 Hedge and bank fence.

Sometimes what is called a hedge and bank, or hedge on the top of a bank, is made uſe of. It conſiſts of a bank of earth taken from the adjoining grounds, broad at bottom and tapering towards the top, along the ſummit of which the hedge is planted. Such hedges are extremely liable to decay, in conſequence of the artificial mound on which they ſtand, being unable to retain ſufficient moiſture for their ſupport, or being waſhed away from about their roots.

712 Devonſhire fence.

The Devonſhire fence reſembles the one now deſcribed. It conſiſts of an earthen mound 7 feet wide at bottom, and 4 feet at the top, and 5 feet in height. In the middle of the top of it a row of quicks is planted, and on each ſide at two feet diſtance a row of willow ſtakes, of about an inch in diameter each, and from 18 inches to two feet in length, is ſtuck in, ſloping a little outwards. Theſe ſtakes take root, and form a kind of live fence for the preſervation of the quicks in the middle.

Palings are frequently employed for the protection of young hedges, whether planted on the plain ſoil or on the top of a ditch: dead hedges, of the kinds formerly mentioned, are alſo employed for the ſame purpoſe. The dead hedge is preferable to the paling, as it ſhelters the young plants from the inclemency of the weather. The dead hedge, however, ought always to be at ſome diſtance from the living one, to allow the latter freely to put forth its branches. As already noticed, walls of different kinds are ſometimes erected, whether Galloway dikes or of ſtone and lime, for the protection of young hedges; but there is a mode of making a hedge in the middle or in the face of a wall which deſerves attention. It is executed in the following manner: The face of the bank is firſt cut down not quite perpendicular, but nearly ſo. A facing of ſtone is then begun at the bottom, and carried up regularly in the manner that ſtone walls are generally built. When it is raiſed about 18 inches or 2 feet high, according to circumſtances, the ſpace between the wall and the bank is filled up with good earth, well broke and mixed with lime or compoſt. The thorns are laid upon this earth in ſuch a manner, as that at laſt 4 inches of the root and ſtem ſhall reſt upon the earth, and the extremity of the top ſhall project beyond the wall. When the plants are thus regularly laid, the roots are covered with earth, and the wall continued upwards, a hole having been left which each plant peeps through. As the wall advances upwards, the ſpace between it and the bank is gradually filled up: when completed the wall is finiſhed with a coping of ſod or of ſtone and lime. When the plants begin to vegetate, the young ſhoots appear in the face of the wall, riſing in a perpendicular direction.

713 Hedge in the face of a wall.

It is ſaid, that Sir James Hall of Dunglaſs has adopted this mode of incloſing to a conſiderable extent in Eaſt Lothian; that the hedges have made great progreſs; and that they exhibit, upon the whole, an extremely handſome appearance.

714 Belts of planting.

Whatever may be thought of the propriety of planting trees in hedge-rows, there can be no doubt, that in certain ſituations the addition to a hedge or hedge and ditch of a belt of planting is a valuable acquiſition to its owner and to the country. It is certain, however, as formerly ſtated, that in low rich ſoils where corn is chiefly cultivated, particularly when ſurrounded by hills, belts of planting are not only unneceſſary, but even hurtful to the crop. But there are other ſituations in which they are of the higheſt value. The peninſula, which forms the county of Caithneſs, is ſaid to be a proof of this. Its ſoil is of a good quality, but its value is greatly impaired by its being expoſed to ſea-winds, whoſe ſeverity checks all vegetation. Many tracts throughout the iſland are nearly in the ſame ſituation; and in all of them nothing more is wanted to improve the country than to interſect it in a judicious manner with hedges and belts of planting. Where belts of planting are meant to remain as an efficient fence, they ought to be of a conſiderable breadth. In poor and cold ſituations the breadth ought to be ſuch as to allow ſpace for planting a great number of trees, which, from the ſhelter they mutually afford, may protect each others growth againſt the ſeverity of the climate. With the ſame view, in cold and expoſed ſituations, the young trees ſhould be planted very thick; perhaps four or five times the number that can grow to a full ſize ſhould be planted. This practice affords a choice of the moſt healthy plants to be left when the plantation is thinned. In belts of planting an error is ſometimes committed of mingling firs, larches, and pines, with oaks, aſhes, &c. with the intention that the evergreens ſhould protect for a certain time the other trees, and thereafter be removed. The effect of which too frequently is, that when the evergreens are taken away, their growth is not only checked for ſeveral years; but being unable, after experiencing ſo much ſhelter, to reſiſt the ſeverity of the climate, they die altogether. This is the more likely to happen in conſequence of the rapidity with which the firs and larches grow; for the oaks and other trees are drawn up along with them, and acquire, in ſome meaſure, the nature of hot-houſe plants, unfit to encounter the blaſts of a northern climate: hence belts of planting ſhould either be made altogether of evergreens or altogether of deciduous plants, ſuch as oak, aſh, &c. If the evergreens are at all introduced among theſe laſt, it ought to be ſparingly, and at the outſide of the belt, with the view to afford only a moderate degree of ſhelter.

Where fields are meant to remain conſtantly in paſturage, the belts may be made in a ſerpentine, and ſometimes in a circular form, both for the ſake of ornament, and to afford more complete ſhelter; but this cannot be done where the plough is meant to be introduced. Upon a north expoſure, the belts ſhould croſs each other at proper diſtances to afford more complete ſhelter. Upon a ſouth expoſure, they ought to run from ſouth, to north to afford a defence againſt the eaſt and weſt winds which are the ſtrongeſt in this country.

Fences. country. Belts of planting require themſelves to be fenced. A fence, which is merely intended to protect their growth, may conſiſt of a mud wall; but if a permanent ſecurity is wanted, a hedge and ditch will be neceſſary.

In ſome ſituations, inſtead of the belt of planting, it is cuſtomary to plant only the corners of the fields; and this plan is adviſable where the country requires but a moderate degree of ſhelter, added to that which it may derive from thriving hedges.

It has been propoſed, that on all ſheep farms of any extent, there ought to be one or more circular belts of planting, incloſing a ſpace of about an acre or an acre and a half in the centre, with a ſerpentine road leading through the belt into this incloſure, the uſe of which is evident. In heavy falls of ſnow numerous flocks are ſometimes buried, and the lives of the ſhepherds are not unfrequently loſt in attempting to drive them to a place of ſafety. On ſuch occaſions, the incloſures we have now mentioned, would be of the utmoſt value. When a ſtorm threatened, the ſheep might be driven to theſe incloſures where the ſnow could never be piled up by driving winds; and they might there be fed and remain with entire ſafety. If due care were taken to litter the place, a quantity of valuable dung might be collected, if the ſtorm ſhould remain for any length of time.

715 The reed fence.

The reed fence has hitherto been only uſed in gardens. It conſiſts of a kind of wall, formed by ſewing with wrought yarn bundles of reeds, applied perpendicularly to a railing. This fence ſeems well adapted for giving temporary ſhelter to cattle, but as the materials of it cannot be everywhere found, its uſe muſt be very limited.

Fences.

716 Gate-poſts.

The entry to every incloſure ought to be ſecured by gate-poſts; which, if circumſtances will permit, ought always to be of ſtone, and if poſſible, of hewn ſtone, as theſe, when properly conſtructed, will never fail. Trees are ſometimes planted for this purpoſe, and when they have acquired a certain ſize, they are cut over about ten feet above the ſurface of the ground. Theſe form the moſt durable of all gate-poſts. They ſometimes, however, miſgive; in which caſe it is difficult to repair the defect. When gate-poſts are made of dead timber they ſhould be ſtrong, and the wood well prepared by a coat of oil paint, as already mentioned.

717 Gates.

Of gates for incloſures there are different kinds. What is called the *ſwing-gate*, that croſſes the whole breadth of a carriage road, and is of one piece, is by no means an adviſable form. The length of its bars renders it expenſive, and its great weight with which it pulls againſt the gate-poſt, overſtrains its own hinges, and is apt to bring down the ſide of the gate, unleſs it is erected in a very coſtly and ſolid manner. For this reaſon, a gate with two folding doors is preferable: it hangs upon the gate-poſt only with half its weight, in conſequence of its being divided into two parts. Its hinges are not ſo liable to be hurt by ſtraining, nor are its joints ſo liable to be broke. What is called the *ſlip-bar gate*, conſiſting of three ſeparate bars which are taken out, and put into the gate-poſts every time the entry to the fields is opened and ſhut, is the beſt kind of gate, ſo far as cheapneſs and durability are concerned; but it does not admit of being locked, which renders it unfit for uſe near a public road, and the opening and ſhutting of it are alſo attended with a conſiderable degree of trouble.

INDEX.

Butter

Flax,

3

Agrifolium ‖ Agrigentum.

AGRIFOLIUM, or AQUIFOLIUM. See ILEX, BOTANY *Index*.

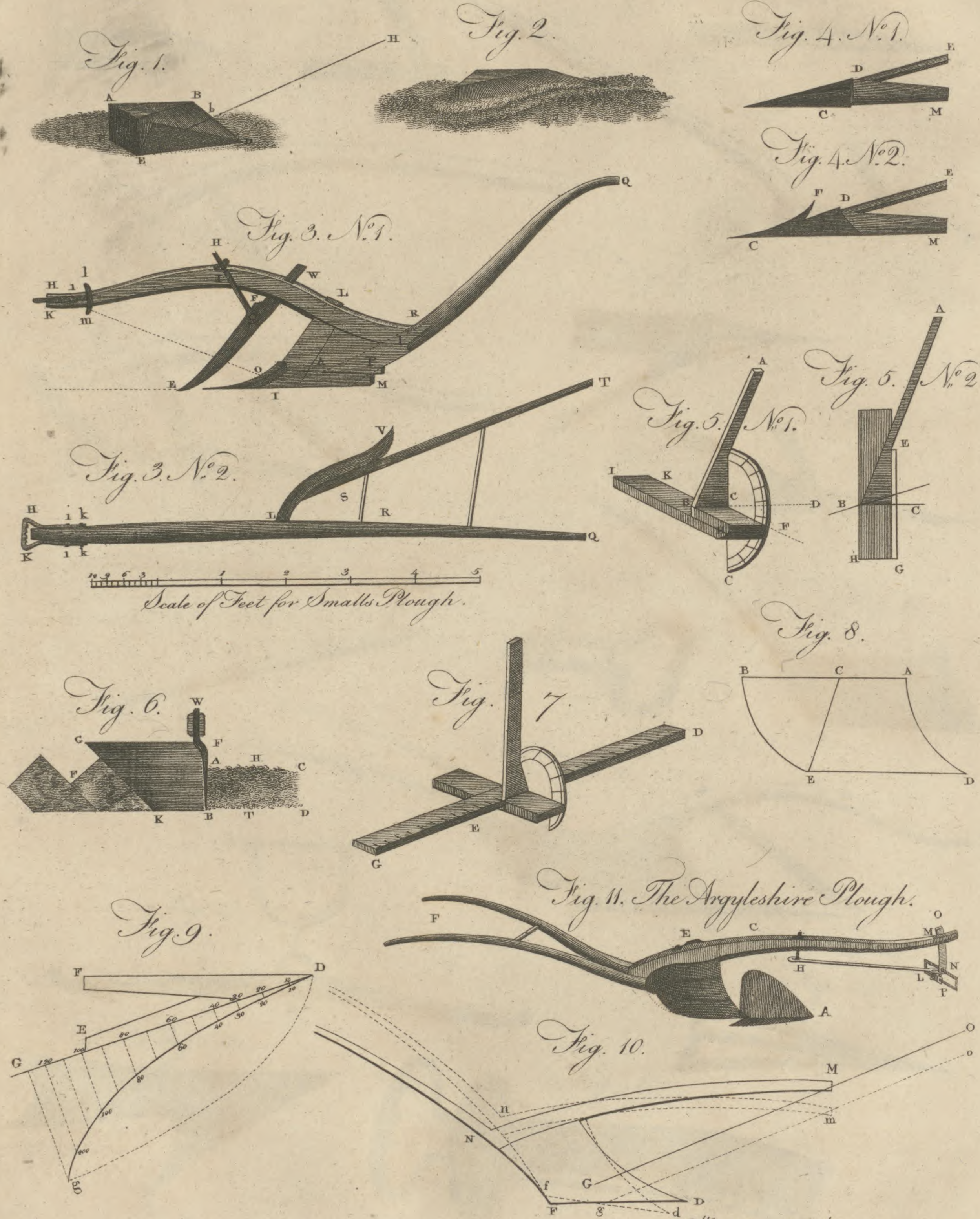
AGRIGAN, or island of St Francis Xavier, in *Geography*, one of the Ladrone or Marianne islands. It is 50 miles in circumference, is very mountainous, and has a volcano in it; situated in N. Lat. 19. 4. E. Long. 146.

AGRIGENTUM, in *Ancient Geography*, a city of Sicily, part of the site of which is now occupied by a town called *Girgenti* from the old name. See GIRGENTI.

According to ancient authors, Dedalus, the most famous mechanician of fabulous antiquity, fled to this spot for protection against Minos, and built many wonderful edifices for Cocalus king of the island. Long after his flight, the people of Gela sent a colony hither 600 years before the birth of Christ; and from the name of a neighbouring stream called the new city *Acragas*, whence the Romans formed their word *Agrigentum*. These Greeks converted the ancient abode of the Siculi into a citadel to guard the magnificent city which they erected on the hillocks below.

An advantageous situation, a free government with all its happy effects, and an active commercial spirit, exalted their commonwealth to a degree of riches and power unknown to the other Greek settlements, Syracuse alone excepted. But the prosperity of Agrigentum appears to have been but of short duration, and tyranny soon destroyed its liberties.

Phalaris was the first who reduced it to slavery. His name is familiar to most readers on account of his cruelty, and the brazen bull in which he tortured his enemies. (See PHALARIS.)—Phalaris met with the common fate of tyrants, and after his death the Agrigentines enjoyed their liberty for 150 years; at the expiration of which term Thero usurped the sovereign authority. The moderation, justice, and valour of this prince preserved him from opposition while living, and have rescued his memory from the obloquy of posterity. He joined his son-in-law Gelo, king of Syracuse, in a war against the Carthaginians; in the course of which victory attended all his steps, and Sicily saw herself for a time delivered from her African oppressors. Soon after his decease, his son Thrasydeus was deprived of the diadem, and Agrigentum restored to her old democratical government. Ducetius next disturbed the general tranquillity. He was a chief of the mountaineers, descendants of the Siculi; and was an overmatch for the Agrigentines while they were unsupported by alliances, but sank under the weight of their union with the Syracusans. Some trifling altercations dissolved this union, and produced a war, in which the Agrigentines were worsted, and compelled to submit to humiliating terms of peace. Resentment led them to embrace with joy the proposals of the Athenians, then meditating an attack upon Syracuse. Their new friends soon made them feel that the sacrifice of liberty and fortune would be the price of their protection; and this consideration brought them speedily back to their old connexions. But as if it had been decreed that all friendship should be fatal to their repose, the reconciliation and its effects drew upon them the anger of the Carthaginians. By this enemy their armies were routed, their city taken, their race almost extirpated, and scarce a vestige of magnificence was left. Agrigentum lay 50 years buried under its own ruins; when Timoleon, after triumphing over the Carthaginians, and restoring liberty to Sicily, collected the descendants of the Agrigentines, and sent them to re-establish the dwellings of their forefathers. Their exertions were rewarded with astonishing success; for Agrigentum rose from its ashes with such a renewal of vigour, that in a very short time we find it engaged in the bold scheme of seizing a lucky moment, when Agathocles and Carthage had reduced Syracuse to the lowest ebb, and arrogating to itself supremacy over all the Sicilian republics. Xenodicus was appointed the leader of this arduous enterprise; and had his latter operations been as fortunate as his first campaign, Agrigentum would have acquired such a preponderance of reputation and power, that the rival states would not have even dared to attack it. But a few



A. Bell Prin. Wal. Sculptor fecit.

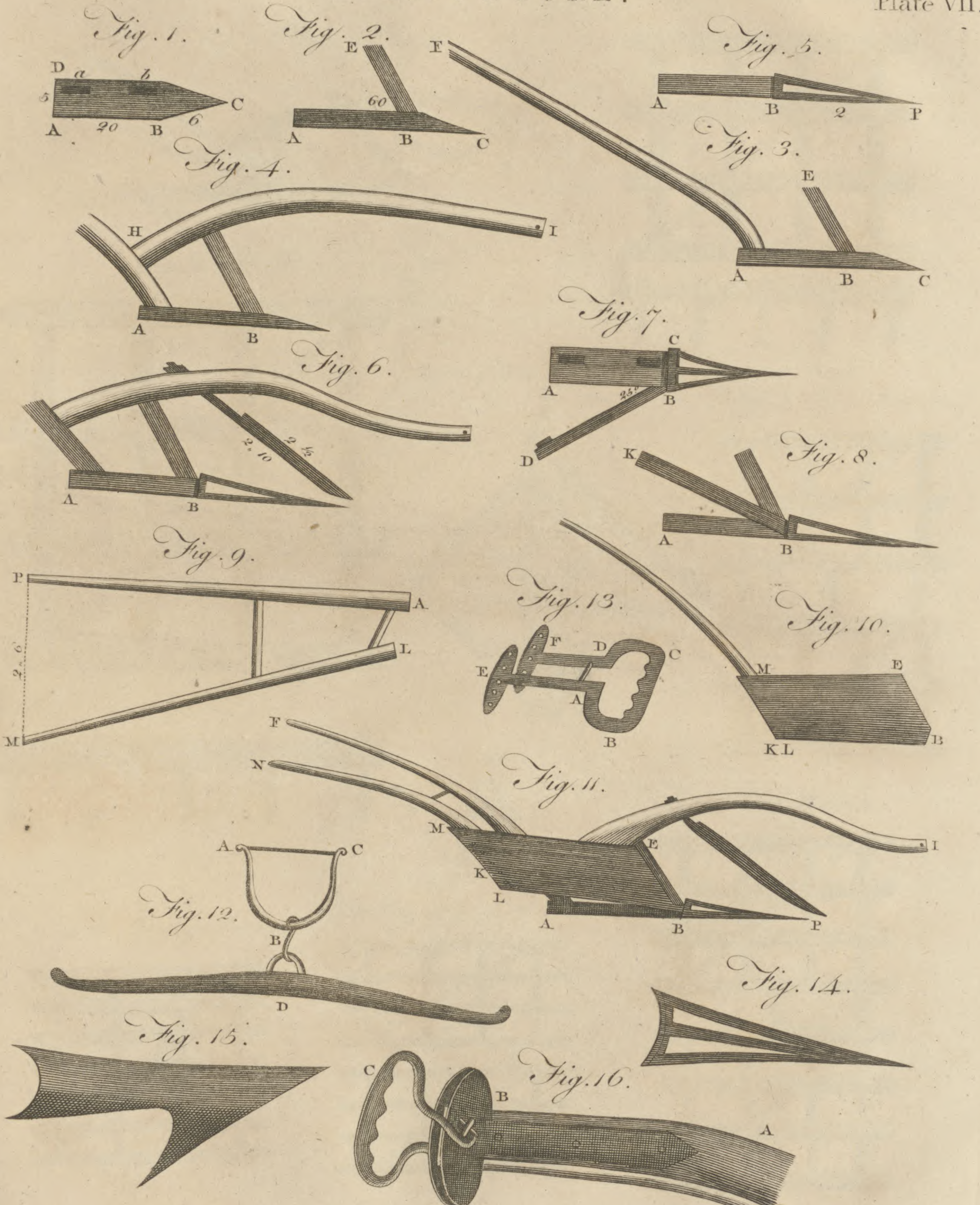


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Fig. 1. Chain Plough.

Fig. 2. Brake.

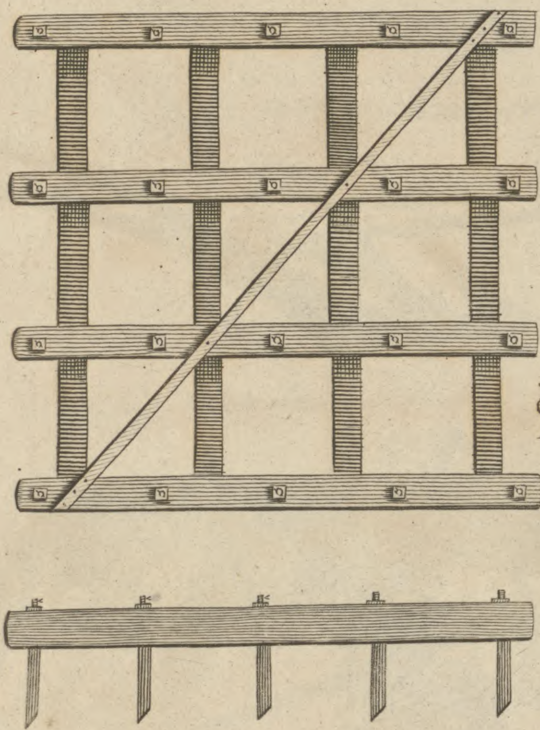


Fig. 3. first Harrow.

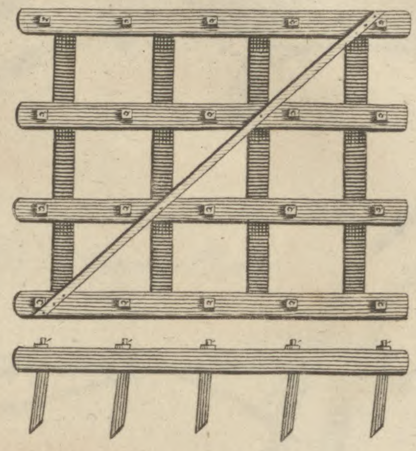


Fig. 8. Chain & Screw Harrow.

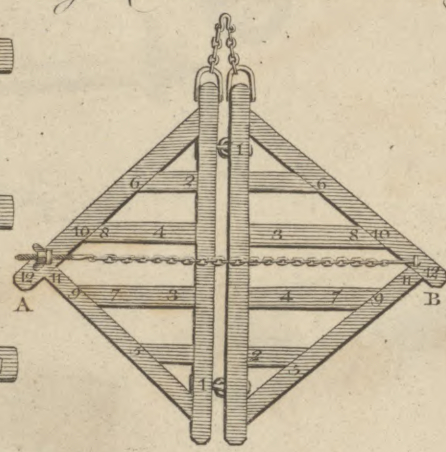


Fig. 4. second Harrow.

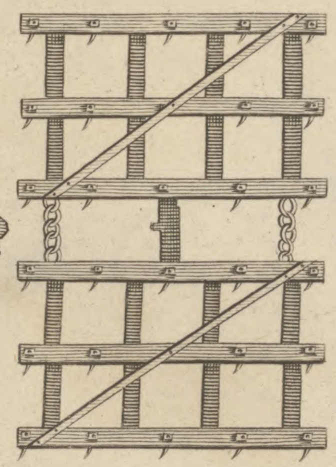


Fig. 5. third Harrow.

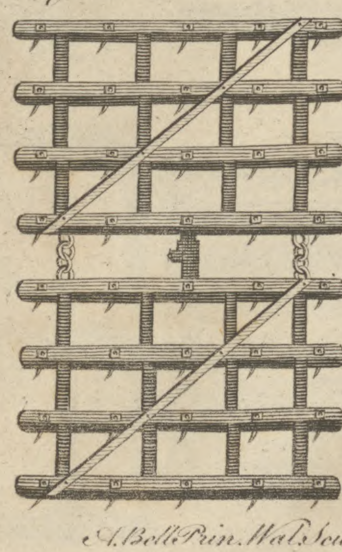


Fig. 6. Cleaning Harrow.

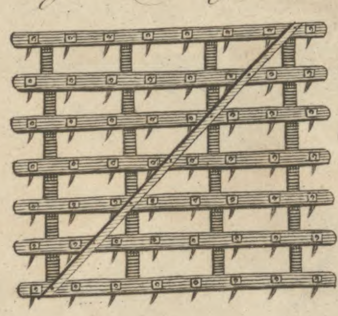
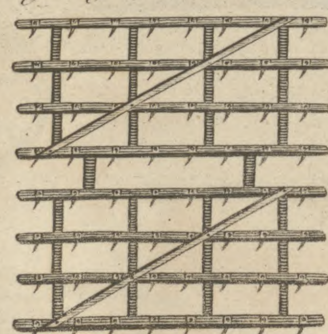


Fig. 7. Grass seed Harrow.



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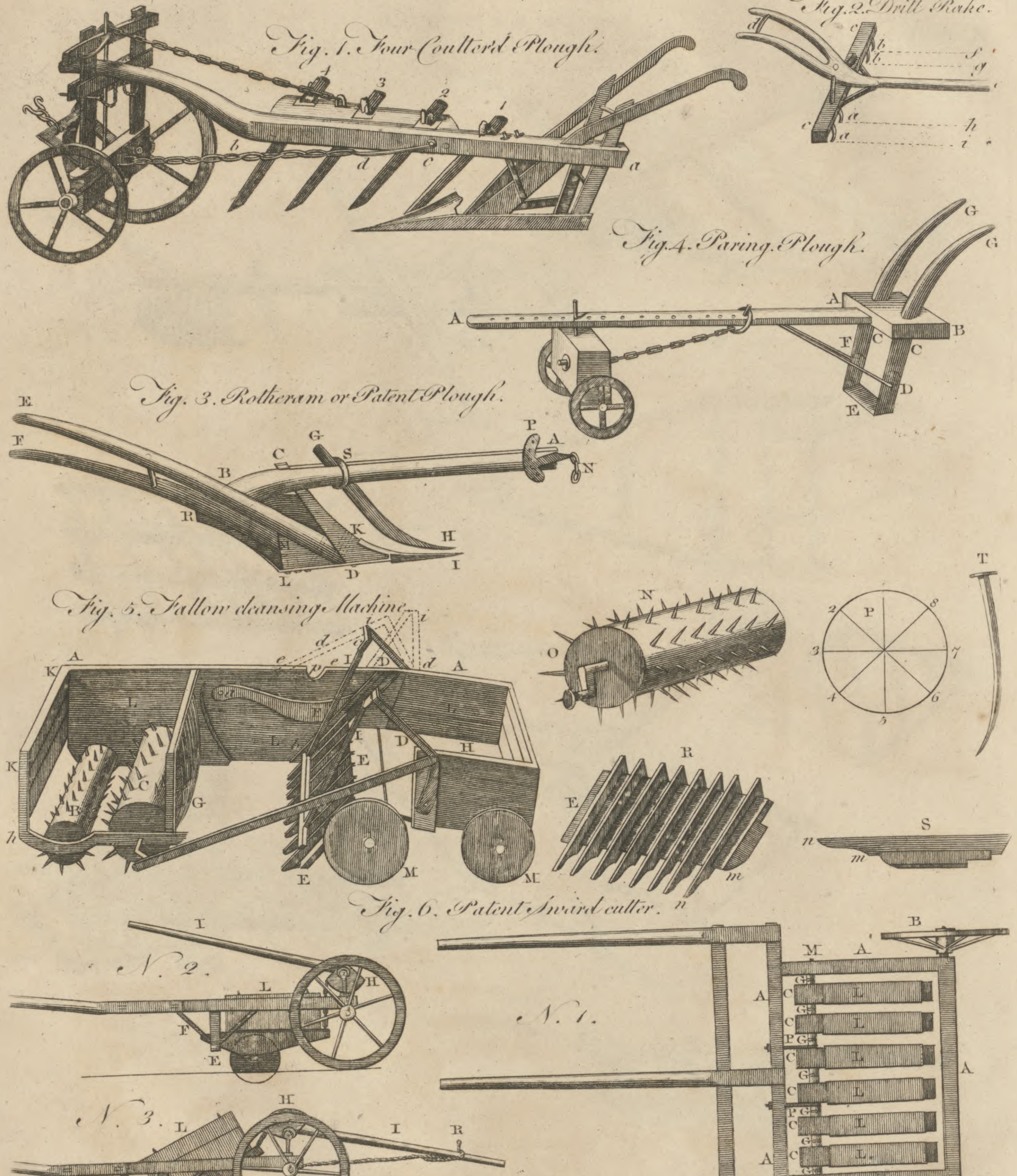
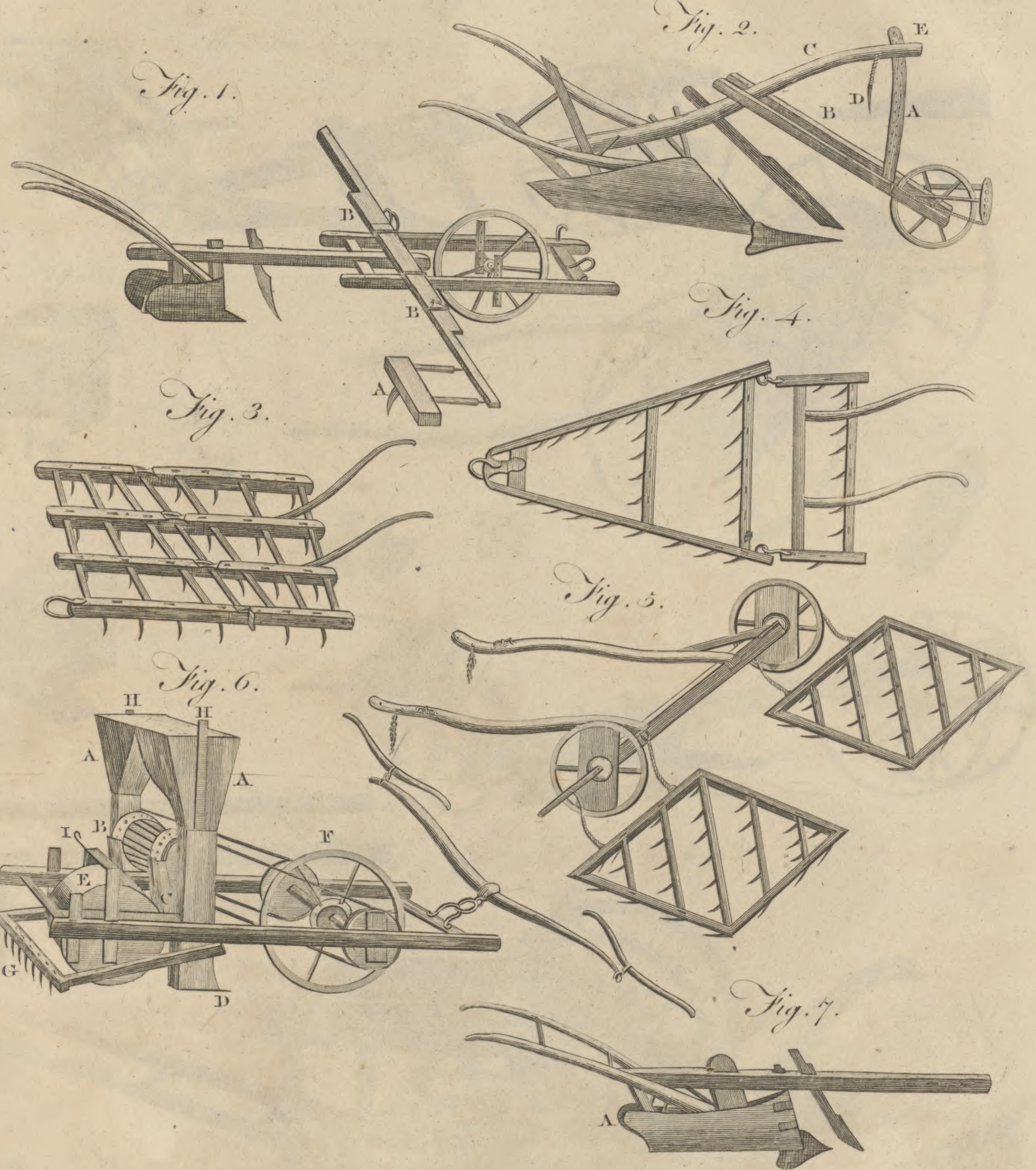


A. Bell Prin Wal Sculptor fecit.

AGRICULTURE. Plate X.



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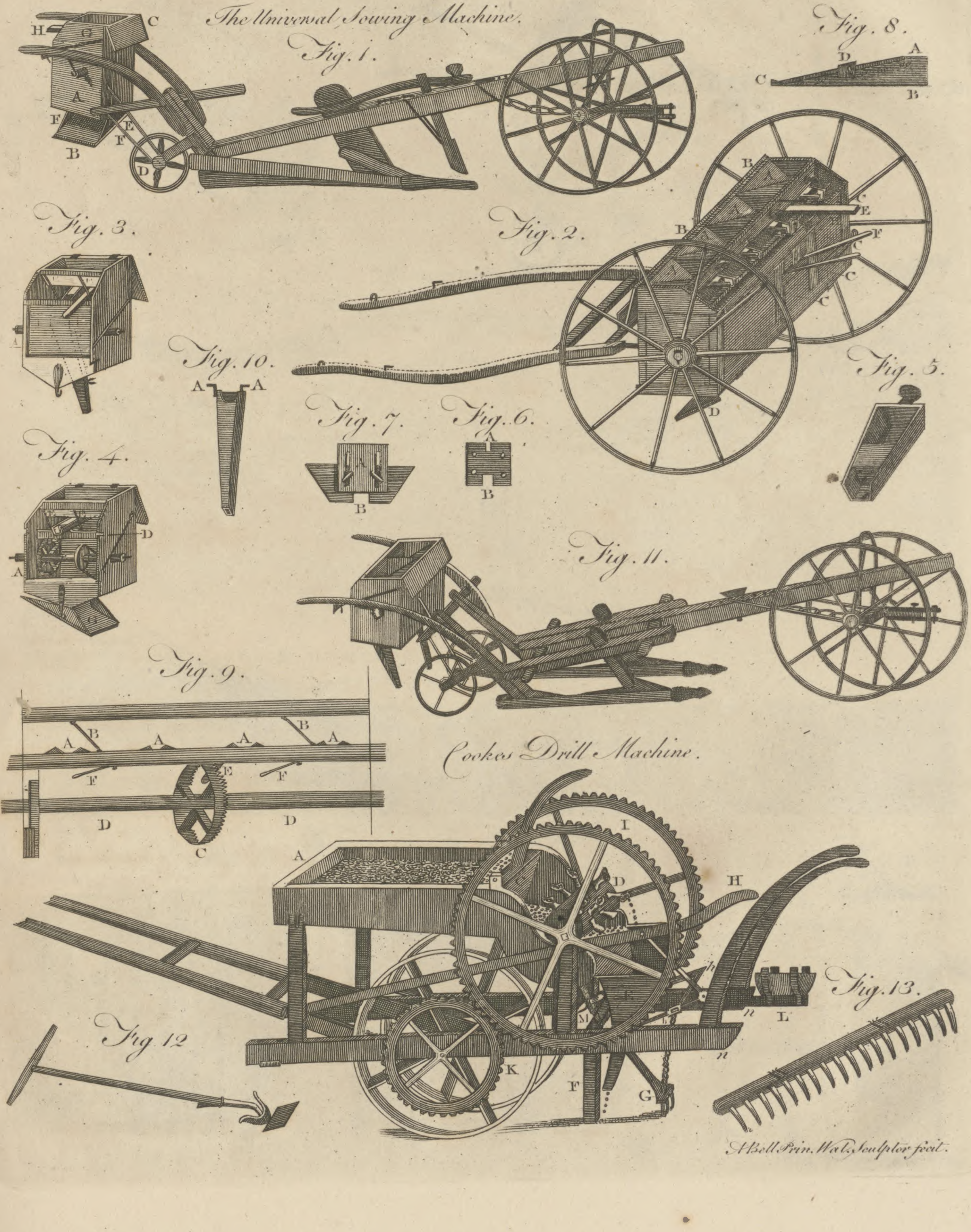
The Universal Sowing Machine.
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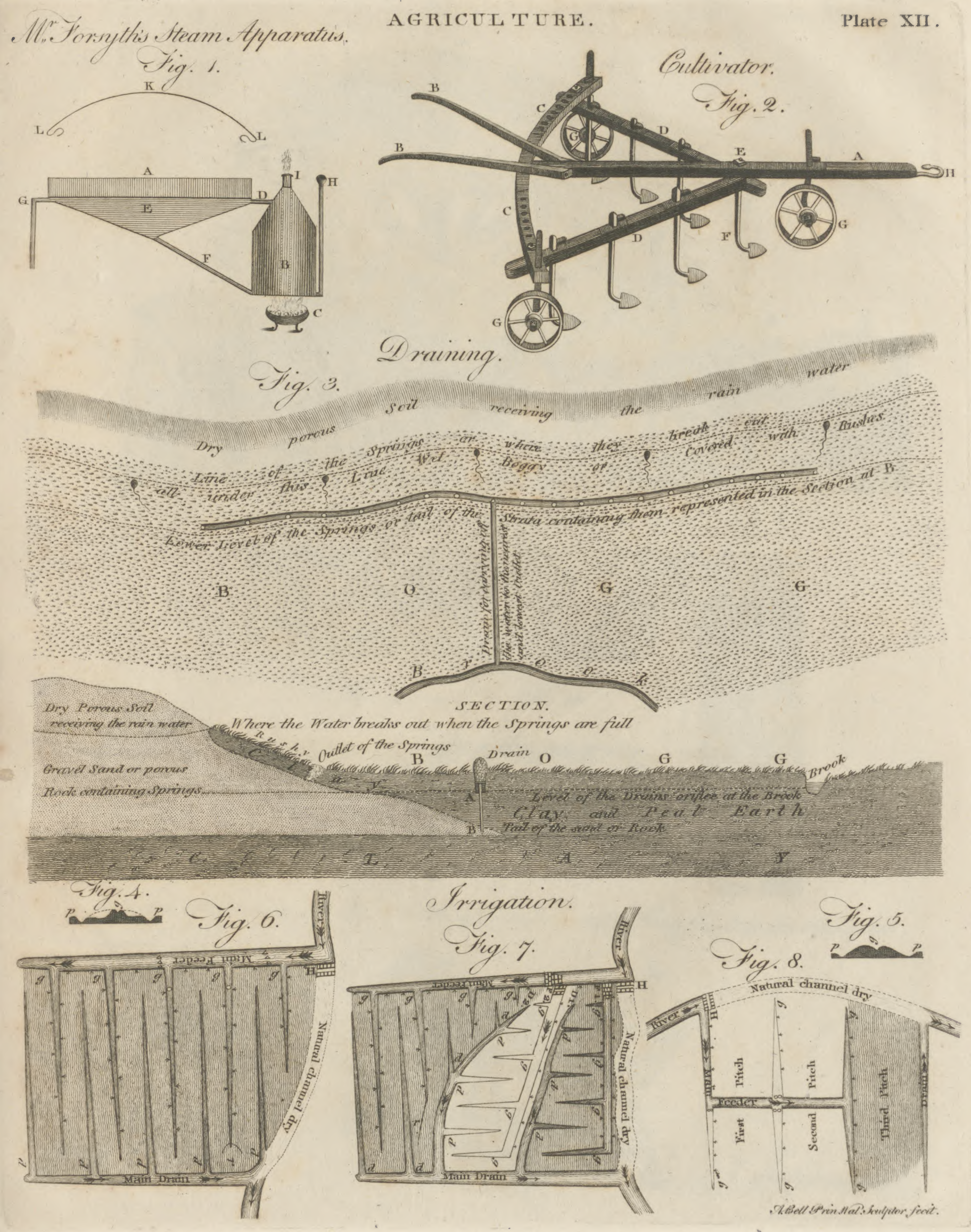
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Natural channel dry
River
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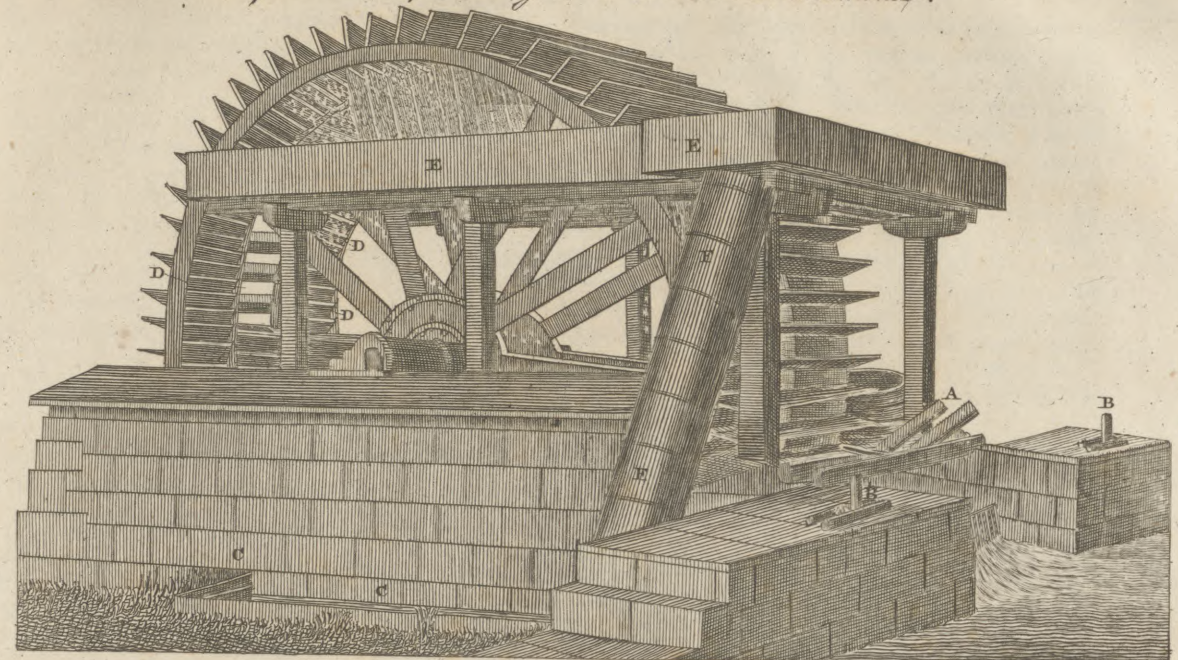
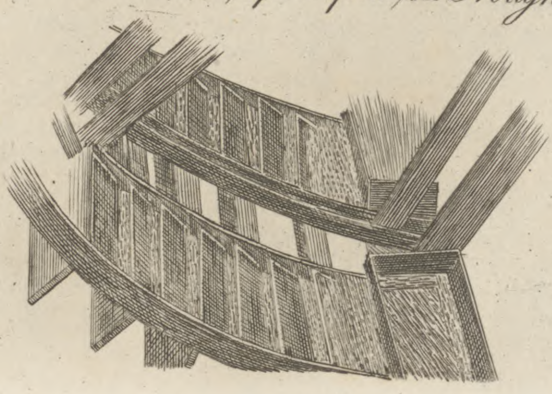
Second Pitch
Third Pitch
Feeder
Main
Drain
A. Bell Prin. Wal. Sculptor fecit.

Sketch of the Wheel for raising Water at Blair Drummond.



Sketch of the Cistern as seen from above.

Sketch of the manner in which the Water is filled from the Troughs into the Buckets.



A.Bell Prin. Wal. Sculptor fecit.

Agrigentum.

few brilliant exploits were ſucceeded by a ſevere overthrow; the Agrigentines loſt courage, diſagreed in council, and humbly ſued for peace to Agathocles. This commonwealth afterwards took a ſtrong part with Pyrrhus; and when he left Sicily to the mercy of her enemies, threw itſelf into the arms of Carthage. During the firſt Punic war Agrigentum was the head quarters of the Carthaginians, and was beſieged by the Roman conſuls, who after eight months blockade took it by ſtorm. It nevertheleſs changed maſters ſeveral times during the conteſt between theſe rival ſtates, and in every inſtance ſuffered moſt cruel outrages. After this period very little mention of it occurs in hiſtory, nor do we know the preciſe time of the deſtruction of the old city and the building of the new one. See GIRGENTI.

The principal part of the ancient city lay in the vale; the preſent town, called *Girgenti*, occupies the mountain on which the citadel of Cocalus ſtood.

It was difficult to be more judicious and fortunate in the choice of ſituation for a large city. The inhabitants were here provided with every requiſite for defence, pleaſure, and comfort of life; a natural wall, formed by abrupt rocks, preſented a ſtrong barrier againſt aſſailants; pleaſant hills ſheltered them on three ſides without impeding the circulation of air; before them a broad plain, watered by the Acragas, gave admittance to the ſea breeze, and to a noble proſpect of that awful element; the port or emporium lay in view at the mouth of the river, and probably the road acroſs the flat was lined with gay and populous ſuburbs.

The hoſpitality and parade for which the Agrigentines are celebrated in hiſtory were ſupported by an extenſive commerce; by means of which, the commonwealth was able to reſiſt many ſhocks of adverſity, and always to riſe again with freſh ſplendour. It was, however, cruſhed by the general fall of Grecian liberty; the feeble remnants of its population, which had ſurvived ſo many calamities, were at length driven out of its walls by the Saracens, and obliged to lock themſelves up for ſafety among the bleak and inacceſſible rocks of the preſent city.

At the north-eaſt angle of the ancient limits, upon ſome foundations of large regular ſtones, a church has been erected; a road appears hewn in the ſolid rock for the convenience of the votaries who viſited this temple in ancient days. It was then dedicated to Ceres and her daughter Proſerpine, the peculiar patroneſſes of Sicily.

At the ſouth-eaſt corner, where the ground, riſing gradually, ends in a bold eminence, which is crowned with majeſtic columns, are the ruins of a temple ſaid to have been conſecrated to Juno. To the weſt of this ſtands the building commonly called the *Temple of Concord;* the ſtone of which, and the other buildings, is the ſame as that of the neighbouring mountains and cliffs, a conglutination of ſea ſand and ſhells, full of perforations, of a hard and durable texture, and a deep reddiſh brown colour. This Doric temple has all its columns, entablature, pediments, and walls entire; only part of the roof is wanting. It owes its preſervation to the piety of ſome Chriſtians, who have covered half the nave, and converted it into a church conſecrated under the invocation of St Gregory biſhop of Girgenti.

Proceeding in the ſame direction, you walk between rows of ſepulchres cut in the rock wherever it admitted of being excavated by the hand of men, or was ſo already by that of nature. Some maſſes of it are hewn into the ſhape of coffins; others drilled full of ſmall ſquare holes employed in a different mode of interment, and ſerving as receptacles of urns. One ponderous piece of the rock lies in an extraordinary poſition; by the failure of its foundation, or the ſhock of an earthquake, it has been looſened from the general quarry, and rolled down the declivity, where it now remains ſupine with the cavities turned upwards. Only a ſingle column marks the confuſed heap of moſs-grown ruins belonging to the temple of Hercules. It ſtood on a projecting rock above a chaſm in the ridge, which was cut through for a paſſage to the emporium.

In the ſame tract, over ſome hills, is ſituated the building uſually called the *Tomb of Thero.* It is ſurrounded by aged olive trees, which caſt a wild irregular ſhade over the ruin. The edifice inclines to the pyramidical ſhape, and conſiſts at preſent of a triple plinth, and a baſe ſupporting a ſquare pedeſtal; upon this plain ſolid foundation is raiſed a ſecond order, having a window in each front, and at each angle two Ionic pilaſters crowned with an entablature of the Doric order. Its inſide is divided into a vault, a ground room, and one in the Ionic ſtory, communicating with each other by means of a ſmall internal ſtaircaſe.

In the plain are ſeen the fragments of the temple of Æſculapius; part of two columns and two pilaſters, with an intermediate wall, ſupport the end of a farmhouſe, and were probably the front of the cella. Purſuing the track of the walls towards the weſt, you arrive at a ſpot which is covered with the gigantic remains of the temple of the Olympian Jupiter, minutely deſcribed by Diodorus Siculus. It may literally be ſaid that it has not one ſtone left upon another; and it is barely poſſible, with the help of much conjecture, to diſcover the traces of its plan and dimenſions. Diodorus calls it the largeſt temple in the whole iſland: but adds, that the calamities of war cauſed the work to be abandoned before the roof could be put on; and that the Agrigentines were ever after reduced to ſuch a ſtate of poverty and dependence, that they never had it in their power to finiſh this ſuperb monument of the taſte and opulence of their anceſtors. The length of this temple was 370 Greek feet, its breadth 60, and its height 220, excluſive of the foundations or baſement ſtory; the extent and ſolidity of its vaults and underworks were wonderful; its ſpacious porticoes and exquiſite ſculpture were ſuited to the grandeur of the whole. It was not built in the uſual ſtyle of Sicilian temples with a cella of maſſive walls and a periſtyle, but was deſigned in a mixt taſte with half columns let into the walls on the outſide, the inſide exhibiting a plain ſurface.

The next ruin belongs to the temple of Caſtor and Pollux: vegetation has covered the lower parts of the building, and only a few fragments of columns appear between the vines. This was the point of the hill where the wall ſtopt on the brink of a large fiſh-pond ſpoken of by Diodorus: it was cut in the ſolid rock

Agrimonia ‖ Agrippa.

30 feet deep, and water was conveyed to it from the hills. In it was bred a great quantity of fish for the use of public entertainments; swans and various other kinds of wild fowl swam along its surface, for the amusement of the citizens, and the great depth of water prevented an enemy from surprising the town on that side. It is now dry and used as a garden. On the opposite bank, are two tapering columns without their capitals, most happily placed in a tuft of carob trees. Monte Toro, where Hanno encamped with the Carthaginian army, before the Roman consuls drew him into an engagement that ruined his defensive plan, is a noble back-ground to this picturesque group of objects. —The whole space comprehended within the walls of the ancient city abounds with traces of antiquity, foundations, brick-arches, and little channels for the conveyance of water; but in no part are any ruins that can be presumed to have belonged to places of public entertainment. This is the more extraordinary, as the Agrigentines were a sensual people, fond of shows and dramatic performances, and the Romans never dwelt in any place long without introducing their savage games. Theatres and amphitheatres seem better calculated than most buildings to resist the outrages of time; and it is surprising that not even the vestiges of their form should remain on the ground.

AGRIMONIA, Agrimony. See Botany *Index*.

Hemp Agrimony. See Eupatorium, Botany *Index*.

Water Hemp Agrimony. See Bidens, Botany *Index*.

AGRIONIA, in *Grecian Antiquity*, festivals annually celebrated by the Bœotians in honour of Bacchus. At these festivals, the women pretended to search after Bacchus as a fugitive; and, after some time, gave over their inquiry, saying, that he had fled to the Muses, and was concealed among them.

AGRIOPHAGI, in *Antiquity*, a name given to those who fed on wild beasts. The word is Greek, compounded of αγριος, "wild," "savage," and φαγω, "I eat." The name is given, by ancient writers, to certain people, real or fabulous, said to have fed altogether on lions or panthers. Pliny and Solinus speak of *Agriophagi* in Ethiopia, and Ptolemy of others in India on this side the Ganges.

AGRIPPA, Cornelius, born at Cologne in 1486, a man of considerable learning, and by common report a great magician; for the monks at that time suspected every thing of heresy or sorcery which they did not understand. He composed his *Treatise of the Excellence of Women*, to insinuate himself into the favour of Margaret of Austria, governess of the Low-Countries. He accepted of the charge of historiographer to the emperor, which that princess gave him. The treatise of the *Vanity of the Sciences*, which he published in 1530, enraged his enemies extremely; as did that of *Occult Philosophy*, which he printed soon after at Antwerp. He was imprisoned in France for something he had written against Francis I.'s mother; but was enlarged, and went to Grenoble, where he died in 1534. His works are printed in two volumes octavo.

Agrippa, *Herod*, the son of Aristobulus and Mariamne, and grandson to Herod the Great, was born in the year of the world 3997, three years before the birth of our Saviour, and seven years before the vulgar æra. After the death of Aristobulus his father, Josephus informs us, that Herod his grandfather took care of his education, and sent him to Rome to make his court to Tiberius. The emperor conceived a great affection for Agrippa, and placed him near his son Drusus. Agrippa very soon won the graces of Drusus, and of the empress Antonia. But Drusus dying suddenly, all those who had been much about him were commanded by Tiberius to withdraw from Rome, lest the sight and presence of them should renew his affliction. Agrippa, who had indulged his inclination to liberality, was obliged to leave Rome overwhelmed with debts, and in a very poor condition. He did not think it fit to go to Jerusalem, because he was not able to make a figure there suitable to his birth. He retired therefore to the castle of Massada, where he lived rather like a private person than a prince. Herod the Tetrarch, his uncle, who had married Herodias his sister, assisted him for some time with great generosity. He made him principal magistrate of Tiberias, and presented him with a large sum of money: but all this was not sufficient to answer the excessive expences and profusion of Agrippa; so that Herod growing weary of assisting him, and reproaching him with his bad economy, Agrippa took a resolution to quit Judea, and return to Rome. Upon his arrival, he was received into the good graces of Tiberius, and commanded to attend Tiberius Nero the son of Drusus. Agrippa, however, having more inclination for Caius the son of Germanicus, and grandson of Antonia, chose rather to attach himself to him; as if he had some prophetic views of the future elevation of Caius, who at that time was beloved by all the world. The great assiduity and agreeable behaviour of Agrippa so far engaged this prince, that he kept him continually about him.

Agrippa being one day overheard by Eutyches, a slave whom he had made free, to express his wishes for Tiberius's death and the advancement of Caius, the slave betrayed him to the emperor; whereupon Agrippa was loaded with fetters, and committed to the custody of an officer. Tiberius soon after dying, and Caius Caligula succeeding him, the new emperor heaped many favours and much wealth upon Agrippa; changed his iron fetters into a chain of gold; set a royal diadem upon his head; and gave him the tetrarchy which Philip, the son of Herod the Great, had been possessed of, that is, Batanæa and Trachonitis. To this he added that of Lysanias; and Agrippa returned very soon into Judea to take possession of his new kingdom,

Caius being soon after killed, Agrippa, who was then at Rome, contributed much by his advice to maintain Claudius in possession of the imperial dignity, to which he had been advanced by the army. But in this affair Agrippa acted a part wherein he showed more cunning and address than sincerity and honesty; for while he made a show of being in the interest of the senate, he secretly advised Claudius to be resolute, and not to abandon his good fortune. The emperor, as an acknowledgment for his kind offices, gave him all Judea and the kingdom of Chalcis, which had been possessed by Herod his brother. Thus Agrippa became of a sudden one of the greatest princes of the east; and was possessed of as much, if not more territories

ritories than had been held by Herod the Great his grandfather. He returned to Judea, and governed it to the great ſatisfaction of the Jews. But the deſire of pleaſing them, and a miſtaken zeal for their religion, induced him to commit an unjuſt action, the memory of which is preſerved in Scripture, Acts xii. 1, 2, &c. for about the feaſt of the paſſover, in the year of Jeſus Chriſt 44, St James major, the ſon of Zebedee and brother of St John the Evangeliſt, was ſeized by his order and put to death. He proceeded alſo to lay hands on St Peter, and impriſoned him, waiting till the feſtival was over, that he might then have him executed. But God having miraculouſly delivered St Peter from the place of his confinement, the deſigns of Agrippa were fruſtrated. After the paſſover, this prince went from Jeruſalem to Cæſarea, and there had games performed in honour of Claudius. Here the inhabitants of Tyre and Sidon waited on him to ſue for peace. Agrippa being come early in the morning to the theatre, with a deſign to give them audience, ſeated himſelf on his throne, dreſſed in a robe of ſilver-tiſſue, worked in the moſt admirable manner. The riſing ſun darted on it with its rays, and gave it ſuch a luſtre as the eyes of the ſpectators could not endure. When therefore the king ſpoke to the Tyrians and Sidonians, the paraſites around him began to ſay, that it was the voice of a god, and not that of a man. Inſtead of rejecting theſe impious flatteries, Agrippa received them with an air of complacency; but at the ſame time obſerved an owl above him on a cord. He had ſeen the ſame bird before when he was in bonds by order of Tiberius; and it was then told him, that he ſhould be ſoon ſet at liberty: but that whenever he ſaw the ſame thing a ſecond time, he ſhould not live above five days afterwards. He was therefore extremely terrified; and he died at the end of five days, racked with tormenting pains in his bowels, and devoured with worms. Such was the death of Herod Agrippa, after a reign of ſeven years, in the year of Chriſt 44.

Agrippa II. ſon of the preceding Herod, was made king of Chalcis; but three or four years after, he was deprived of that kingdom by Claudius, who gave him in the place of it other provinces. In the war Veſpaſian carried on againſt the Jews, Herod ſent him a ſuccour of 2000 men; by which it appears that though a Jew by religion, he was yet entirely devoted to the Romans, whoſe aſſiſtance indeed he wanted to ſecure the peace of his own kingdom. He lived to the third year of Trajan, and died at Rome A. C. 100. He was the ſeventh and laſt king of the family of Herod the Great. It was before him and Berenice his ſiſter that St Paul pleaded his cauſe at Cæſarea.

Agrippa, *Marcus Viſpanius*, ſon in-law to Auguſtus, of mean birth, but one of the moſt conſiderable generals among the Romans. Auguſtus's victory over Pompey and Mark Antony was owing to his counſel. He adorned the city with the pantheon, baths, aqueducts, &c.

AGRIPPINA, daughter of Germanicus, ſiſter of Caligula, and mother of Nero; a woman of wit, but exceſſively lewd. She was thrice married, the laſt time to Claudius her own uncle, whom ſhe poiſoned to make way for Nero her ſon. Nero afterwards cauſed her to be murdered in her chamber, when ſhe bid the executioner ſtab her firſt in the belly that had brought forth ſuch a monſter.

Agrippina colonia ubiorum, in *Ancient Geography*, now *Cologne*: ſo called from Agrippina, the daughter of Germanicus, and mother of Nero, who had a colony ſent thither at her requeſt by the emperor Claudius, to honour the place of her birth. See Cologne.

AGRIPPINIANS, in *Church Hiſtory*, the followers of Agrippinus biſhop of Carthage, in the third century, who firſt introduced and defended the practice of rebaptization.

AGROM, a diſeaſe frequent in Bengal and other parts of the Indies, in which the tongue is parched, chaps, and is ſometimes covered with white ſpots. The Indians are very fearful of this diſeaſe, which they attribute to extreme heat of the ſtomach. Their remedy is, to drink ſome chalybeate liquor, or the juice of mint.

AGROSTEMMA, Wild Lychnis, or Campion, in *Botany*. See Botany *Index*.

AGROSTIS, Bent-grass, in *Botany*. See Botany *Index*.

AGROSTOGRAPHIA, ſignifies the hiſtory or deſcription of graſſes.

AGROUND, the ſituation of a ſhip whoſe bottom, or any part of it, hangs, or reſts upon the ground, ſo as to render her immoveable, till a greater quantity of water floats her off, or till ſhe is drawn out into the ſtream by the application of mechanical powers.

AGRYPNIA, among *Phyſicians*, implies an inaptitude to ſleep; a troubleſome ſymptom of feveriſh and other diſorders.

Agrypnia, in the *Greek Church*, implies the vigil of any of the greater feſtivals.

AGUE, a general name for all periodical fevers, which, according to the different times of the returns of the feveriſh paroxyſm, are denominated tertian, quartan, and quotidian. See Medicine *Index*.

Ague-Cake, the popular name for a hard tumour on the left ſide of the belly, lower than the falſe ribs, ſaid to be the effect of intermittent fevers.

Ague-Tree, a name given to the ſaſſafras, on account of its febrifuge qualities.

AGUEPERSE, a town of France, ſituated on the Lyonnois, in the department of Puy-de-Dome, about 15 miles north of Clermont.

AGUILLANEUF, or Augillaneuf, a form of rejoicing uſed among the ancient Franks on the firſt day of the year. The word is compounded of the French *A* "to," *gui* "miſleto," and *l'an neuf* "the new year." Its origin is traced from a druid ceremony: the prieſts uſed to go yearly in December, which with them was reputed a ſacred month, to gather miſleto of the oak in great ſolemnity. The prophets marched in the front, ſinging hymns in honour of their deities; after them came a herald with a caduceus in his hand; theſe were followed by three druids abreaſt, bearing the things neceſſary for ſacrifice; laſt of all came the chief or arch druid, accompanied with the train of people. The chief druid climbing the oak, cut off the miſſeto with a golden ſickle, and the other druids received it in a white cloth; on the firſt day of the year it was diſtributed among the people, after having bleſſed and conſecrated it by crying *A gui l'an neuf*, to proclaim

proclaim the new year. This cry is ſtill continued in Picardy, with the addition of *Plantez, Plantez*, to wiſh a plentiful year. In Burgundy and ſome other parts, the children uſe the ſame word to beg a new-year's gift. In latter times the name *Aguillaneuf* was alſo given to a ſort of begging, practiſed in ſome dioceſes, for church-tapers, on new year's day, by a troop of young people of both ſexes, having a chief, &c. It was attended with various ridiculous ceremonies, as dancing in the church, &c. which occaſioned the ſynods to ſuppreſs it.

AGUILAR, a town of Spain, in the province of Navarre, about 24 miles weſt from Eſtella.

Aguilar del Campo, a town of Old Caſtile, with the title of marquiſate, about 15 leagues north of the city of Burgos.

AGUILLON, or Aguillonius, Francis, a Jeſuit, born at Bruſſels: he was rector of the Jeſuits college at Antwerp, and eminent for his ſkill in mathematics. He was the firſt who introduced that ſcience among the Jeſuits in the Low Countries: he wrote a book of Optics, and was employed in finiſhing his Catoptrics and Dioptrics, when he died in 1617.

AGUIRRA, Joseph Sænz de, a Benedictine, and one of the moſt learned men of the 17th century, was born March 24. 1630. He was cenſor and ſecretary of the ſupreme council of the inquiſition in Spain, and interpreter of the Scriptures in the univerſity of Salamanca. He printed three volumes in folio upon Philoſophy, a commentary upon Ariſtotle's ten books of Ethics, and other pieces. He died at Rome in 1699.

AGUL, in *Botany*, a ſynonyme of the hedyſarum. See Hedysarum, Botany *Index*.

AGUR. The xxxth chapter of the Proverbs begins with this title: "The words of Agur, the ſon of Jakeh;" which, according to the ſignification of the original terms, may be tranſlated, as the Vulgate has it, *Verba congregantis, filii vomentis;* which tranſlation Le Clerc condemns, ſuppoſing theſe to be proper names which ought not to be tranſlated. Theſe words are rendered by Louis de Dieu: "the words of him who has recollected himſelf, the ſon of obedience." The generality of the fathers and commentators will have it, that Solomon deſcribes himſelf under the name of Agur the ſon of Jakeh; others conjecture that Agur, as well as Lemuel (in chap. xxxi. 1.) were wiſe men who lived in the time of Solomon, and were his interlocutors in the book of Proverbs; an opinion which F. Calmet thinks is without the leaſt ſhow of probability, this book being nothing like a dialogue. This laſt expoſitor thinks it probable, that Agur was an inſpired author different from Solomon, whoſe ſentences it was thought fit to join with thoſe of this prince, becauſe of the conformity of their matter.

AGURAH, in *Jewiſh Antiquity*, the name of a ſilver coin, otherwiſe called *gerah* and *keſhita*.

AGURIUM, or Agyrium, in *Ancient Geography*, a town of Sicily in the Val di Demona, near the river Semetus. The people were called *Populus Agyrinenſis* by Cicero; *Agyrinus* by Pliny. It was the birth-place of Diodorus Siculus, as he himſelf teſtifies; but he calls it *Argyrium*, as it is now called *S. Philippo d'Argyrone*, which modern name ſeems to confirm that *Argyrium* is the true reading.

AGUSADURA, in *Ancient Cuſtoms*, a fee due from vaſſals to their lord for the ſharpening their ploughing tackle. Anciently the tenants in ſome manors were not allowed to have their rural implements ſharpened by any but whom the lord appointed; for which an acknowledgment was to be paid, called *agu ſadura*, in ſome places *aguſage:* which ſome take to be the ſame with what was otherwiſe called *reillage*, from the ancient French *reille*, a ploughſhare.

AGUSTINA, a new earth; which, as the word ſignifies, is taſteleſs, inſoluble in water, and when pure reſembles alumina. It was diſcovered in the year 1800 by Trommſdorff in the Saxon beryl. But as his experiments have not been repeated, the exiſtence of this earth reſts ſolely on his authority.

AGUTI, in *Zoology*, the trivial name of a ſpecies of the mouſe, belonging to the mammalia glires of Linnæus.

AGYEI, in *Antiquity*, a kind of obeliſks, ſacred to Apollo, erected in the veſtibules of houſes, by way of ſecurity.

AGYNEIA, in *Botany*. See Botany *Index*.

AGYNIANI, in *Church Hiſtory*, a ſect who condemned all uſe of fleſh, and marriage, as not inſtituted by God, but introduced at the inſtigation of the devil. The word is compounded of the privative α and γυνη *woman*. They are ſometimes alſo called *Agynenſes*, and *Agynii:* and are ſaid to have appeared about the year 694. It is no wonder they were of no long continuance. Their tenets coincide in a great meaſure with thoſe of the Abelians, Gnoſtics, Cerdonians, and other preachers of chaſtity and abſtinence.

AGYRTÆ, in *Antiquity*, a kind of ſtrolling impoſtors running about the country, to pick up money, by telling fortunes at rich men's doors, pretending to cure diſeaſes by charms, ſacrifices, and other religious myſteries; alſo to expiate the crimes of their deceaſed anceſtors, by virtue of certain odours and fumigations; to torment their enemies, by the uſe of magical verſes, and the like. The word is Greek Αγυρται, formed of the verb αγυρω, *I congregate;* alluding to the practice of charlatans or quacks, who gather a crowd about them.

Agyrtæ, among the Greeks, amount to the ſame with *Æruſcatores* among the Latins, and differ not much from Gypſies among us.

AHAB, ſon of Omri king of Iſrael, ſucceeded his father A. M. 3086, and ſurpaſſed all his predeceſſors in impiety and wickedneſs. He married Jezebel the daughter of Ethbaal king of the Zidonians, who introduced the idols of Baal and Aſtarte among the Iſraelites, and engaged Ahab in the worſhip of theſe falſe deities. God, being provoked by the ſins of Ahab, ſent the prophet Elijah to him (1 Kings xvii. 1. *ſeq.*), who declared to him, that there would be a famine of three years continuance. The dearth having laſted three years, the prophet deſired Ahab to gather all the people to Mount Carmel, and with them the prophets of Baal: when they were thus aſſembled, Elijah cauſed fire to deſcend from heaven upon his ſacrifice, after which he obtained of God that it ſhould rain; and then the earth recovered its former fertility. Six years after this, Ben-hadad king of Syria (chap. xx.) laid ſiege to Jeruſalem. But God, provoked at this proud Syrian, ſent a prophet to Ahab, not only to

Ahab. to affure him of victory, but to inftruct him likewife in what manner he was to obtain it. Ahab was ordered to review the princes of the provinces, which he found to be a choice company, confifting of 232 young men, who were to command the people in Samaria, amounting to about 7000 men; with this fmall army Ahab was directed to fall upon the great hoft of the Syrians, and that at noon-day, while Ben-hadad and the 32 kings that accompanied him were drinking and making merry. Ben-hadad having notice that they were marching out of the city, ordered them to be brought before him alive, whatever their defigns were; but the young men, followed by this fmall army, advanced, and killed all that oppofed them. Such a panic feized the Syrian troops, that they began to fly, and even Ben-hadad himfelf mounted his horfe and fled with his cavalry: which Ahab perceiving, purfued them, killed great numbers of them, and took a confiderable booty. After this the prophet came to Ahab, to animate him with frefh courage, and to caution him to keep upon his guard; affuring him, that Ben-hadad would return againft him the year following. According to this prediction, at the end of the year he returned and encamped at Aphek, with a refolution to give the Ifraelites battle. Both armies being ranged in order of battle for feven days fucceffively, at length upon the feventh day, a battle enfued, wherein the Ifraelites killed 100,000 of the Syrians, and the reft fled to Aphek; but as they were preffing to get into the city, the walls of Aphek fell upon them and killed 27,000 more. Ben-hadad throwing himfelf upon the mercy of Ahab, this prince received him into his own chariot, and made an alliance with him. The year following, Ahab defiring to make a kitchen garden near his palace (chap. xxi.), requefted of one Naboth, a citizen of Jezreel, that he would fell him his vineyard, becaufe it lay convenient for him. But being refufed, he returned in great difcontentment to his houfe, threw himfelf upon the bed, turned towards the wall, and would eat nothing. Jezebel his wife coming in, afked the reafon of his great concern; of which being informed, fhe procured the death of Naboth, and Ahab took poffeffion of his vineyard. As he returned from Jezreel to Samaria, the prophet Elijah met him, and faid, "Haft thou killed and alfo taken poffeffion? Now faith the Lord, In the place where dogs licked up the blood of Naboth, fhall dogs lick thy blood, even thine. As for Jezebel, of her the Lord fpoke, faying, The dogs fhall eat Jezebel by the way of Jezreel." Ahab, hearing thefe and other denunciations, rent his clothes, put fackcloth upon his flefh, and gave other indications of his forrow and repentance. But his repentance was neither fincere nor perfevering. Two years after thefe things, Jehofhaphat king of Judah came to Samaria to vifit Ahab (chap. xxii.) at a time when he was preparing to attack Ramoth-gilead, which Ben-hadad king of Syria unjuftly withheld from him. The king of Ifrael invited Jehofhaphat to accompany him in this expedition; which that prince agreed to do, but defired that fome prophet might firft be confulted. Ahab therefore affembled the prophets of Baal, in number about 400; who all concurred in exhorting the king to march refolutely againft Ramoth-gilead. But Micaiah being alfo confulted, at Jehofhaphat's fuggeftion, prophefied the ruin of Ahab. Upon this, Ahab gave orders to his people to feize Micaiah, and to carry him to Amon the governor of the city, and to Joafh the king's fon; telling him in his name, "Put this fellow in prifon, and feed him with the bread of affliction, and with the water of affliction, until I come in peace." But Micaiah faid, "If thou return at all in peace, the Lord hath not fpoken by me." Ahab, therefore, and Jehofhaphat marched up to Ramoth-gilead; and the king of Ifrael faid unto Jehofhaphat, "I will difguife myfelf, and enter into the battle, but put thou on my robe:" for he knew that the king of Syria had commanded two and thirty captains that had rule over his chariots, faying, "Fight neither with fmall nor with great, fave only with the king of Ifrael." Thefe officers, therefore, having obferved that Jehofhaphat was dreffed in royal robes, took him for the king of Ifrael, and fell upon him with great impetuofity: but this prince feeing himfelf preffed fo clofely, cried out; and the miftake being difcovered, the captains of the king of Syria gave over purfuing him. But one of the Syrian army fhot a random arrow, which pierced the heart of Ahab. The battle lafted the whole day, and Ahab continued in his chariot with his face turned towards the Syrians. In the mean time, his blood was ftill iffuing from his wound, and falling in his chariot; and towards the evening he died: whereupon proclamation was made by found of trumpet, that every man fhould return to his own city and country. The king of Ifrael being dead, was carried to Samaria and buried: but his chariot and the reins of his horfes were wafhed in the fifh-pool of Samaria, and the dogs licked his blood, according to the word of the prophet. Such was the end of Ahab. His fon Ahaziah fucceeded him in the year of the world 3107.

Ahab ‖ Ahaz.

AHÆTULA, the trivial name of a fpecies of the coluber. See Coluber.

AHASUERUS, or Artaxerxes, the hufband of Efther; and according to Archbifhop Uſher and F. Calmet, the Scripture name for Darius, the fon of Hyftafpes, king of Perfia; though Scaliger fuppofed Xerxes to have been the hufband of Efther, or the Ahafuerus of Scripture: and Dr Prideaux believes him to be Artaxerxes Longimanus. See Hiftory of Persia.

AHAZ, king of Judah, the fon of Jotham, remarkable for his vices and impieties. One of his fons he confecrated, by making him pafs through and perifh by the fire, in honour of the falfe god Moloch; and he offered facrifices and incenfe upon the high places, upon hills, and in groves. Rezin king of Syria and Pekah king of Ifrael invaded Judea in the beginning of the reign of Ahaz; and having defeated his army and pillaged the country, they laid fiege to Jerufalem. When they found that they could not make themfelves mafters of that city, they divided their army, plundered the country, and made the inhabitants prifoners of war. Rezin and his part of the confederate army marched with all their fpoil to Damafcus; but Pekah with his divifion of the army having attacked Ahaz, killed 120,000 men of his army in one battle, and carried away men, women, and children, without diftinction, to the number of 200,000. But as they were carrying thofe captives to Samaria, the prophet Oded, with the principal inhabitants of the city, came out to meet

Ahaziah ‖ Ahijah.

meet them; and by their remonstrances prevailed with them to set their prisoners at liberty. At the same time, the Philistines and Edomites invaded other parts of his land, killed multitudes of the people, and carried off much booty. In this distressed condition, Ahaz finding no other remedy for his affairs, sent ambassadors to Tiglath-pileser king of the Assyrians; and to engage him to his interest, he stripped the temple and city of all the gold which he could meet with, and sent it as a present. Accordingly Tiglath-pileser marched to the assistance of Ahaz, attacked Rezin and killed him, took his capital Damascus, destroyed it, and removed the inhabitants thereof to Cyrene.

The misfortunes of this prince had no influence to make him better: on the contrary, in the times of his greatest affliction, he sacrificed to the Syrian deities, whom he looked upon as the authors of his calamities, and endeavoured to render propitious to him, by honouring them in this manner. He broke in pieces the vessels of the house of God, shut up the gates of the temple, and erected altars in all parts of Jerusalem. He set up altars likewise in all the cities of Judah, with a design to offer incense on them. At length he died, and was buried in Jerusalem, but not in the sepulchres of the kings of Judah his predecessors: which honour he was deprived of, on account of his iniquitous course of life. Hezekiah his son succeeded him in the year of the world 3287, before Jesus Christ 726.

AHAZIAH, the son and successor of Ahab king of Israel, reigned two years, part alone and part with his father Ahab, who ordained him his associate in the kingdom a year before his death. Ahaziah imitated his father's impieties (1 Kings xxii. 52, *seq.*), and paid his adoration to Baal and Astarte, the worship of whom had been introduced in Israel by Jezebel his mother. The Moabites, who had been always obedient to the kings of the ten tribes ever since their separation from the kingdom of Judah, revolted after the death of Ahab, and refused to pay the ordinary tribute. Ahaziah had not leisure or power to reduce them (2 Kings i. 1, 2, &c.); for about the same time, having fallen through a lattice from the top of his house, he hurt himself considerably, and sent messengers to Ekron, in order to consult Baalzebub, the god of that place, whether he should recover of the indisposition occasioned by this accident. But the prophet Elijah went to Ahaziah, and declared that he should not recover from his illness: and accordingly he died in the year of the world 3108, and Jehoram his brother succeeded to the crown.

AHAZIAH, king of Judah, the son of Jehoram and Athaliah, succeeded his father in the kingdom of Judah, in the year of the world 3119. He walked in the ways of Ahab's house, to which he was allied. He reigned only one year. He was slain by Jehu the son of Nimshi.

AHEAD, a sea term, signifying further onward than the ship, or at any distance before her, lying immediately on that point of the compass to which her stem is directed. It is used in opposition to *astern*, which expresses the situation of any object behind the ship.

AHIJAH, the prophet of Shilo. He is thought to be the person who spoke twice to Solomon from God, once while he was building the temple (1 Kings vi. 11.), at which time he promised him his protection; and at another time (*id.* xi. 6.) after his falling into all his irregularities, when God expressed his indignation with great threatenings and reproaches. Ahijah was one of those who wrote the annals or history of this prince (2 Chr. ix. 29.) The same prophet declared to Jeroboam that he would usurp the kingdom (1 Kings xi. 29, &c.), and that two heifers should alienate him from the Lord, meaning the golden calves erected by Jeroboam, one at Dan, the other at Bethel. About the end of Jeroboam's reign, towards the year of the world 3046, Abijah the son of that prince fell sick; upon which Jeroboam sent his wife to this prophet to inquire what would become of the child. The queen therefore went to Ahijah's house in Shilo, disguised: But the prophet, upon hearing the sound of her feet, said, "Come in, thou wife of Jeroboam, why feignest thou thyself to be another? for I am sent to thee with heavy tidings." Then he commanded her to go and tell Jeroboam all the evil that the Lord had declared he would bring upon his house for his impieties; that so soon as she should enter into the city her son Abijah should die, and should be the only one of Jeroboam's house that should come to the grave or receive the honours of a burial. Ahijah in all probability did not long survive the time of this last prophecy; but with the time and manner of his death we are not acquainted.

Ahitophel.

AHITOPHEL, a native of Gillo, was for some time the counsellor of King David, whom he at length deserted, by joining in the rebellion of Absalom. This prince, upon his being preferred to the crown by the greatest part of the Israelites, sent for Ahitophel from Gillo (2 Sam. xv. 12.) to assist him with his advice in the present state of his affairs: for at that time Ahitophel's counsels were received as the oracles of God himself (chap. xvi. *ult.*) Nothing gave David more uneasiness than this event; and when Hushai his friend came to wait on him and attend him in his flight, he intreated him to return rather to Jerusalem, make a show of offering his services to Absalom, and endeavour to frustrate the prudent measures which should be proposed by Ahitophel. When Absalom was come to Jerusalem, he desired Ahitophel to deliberate with his other counsellors upon the measures which were proper for him to take. Ahitophel advised him in the first place to abuse his father's concubines; so that when his party should understand that he had dishonoured his father in this manner, they might conclude that there were no hopes of a reconciliation, and therefore espouse his interest more resolutely. A tent, therefore, being prepared for this purpose upon the terrace of the king's palace, Absalom, in the sight of all Israel, lay with his father's concubines. The next thing Ahitophel proposed was in the terms following: "Let me now choose out 12,000 men, and I will arise and pursue after David this night, and I will come upon him while he is weary and weak-handed, and I will make him afraid, and all the people that are with him flee, and I will smite the king only; and I will bring back all the people unto thee; the man whom thou seekest is as if all returned: so all the people shall be in peace." This advice was very agreeable to Absalom and all the elders of Israel. However,

Absalom

Abſalom deſired Huſhai to be called to have his opinion. Huſhai being come, and hearing what advice Ahitophel had given, ſaid, "The counſel which Ahitophel has given is not good at this time; what, for the preſent, in my opinion, may do better, is this: Let all Iſrael be gathered unto thee, from Dan even to Beerſheba, as the ſand that is by the ſea for multitude, and put thyſelf in the midſt of them, and whereever David is, we may fall upon him, and overwhelm him with our numbers, as the dew falleth upon the ground." This laſt advice being more agreeable to Abſalom and all the elders of Iſrael, was preferred; upon which Ahitophel ſaddled his aſs, went to his houſe at Gillo, hanged himſelf, and was buried in the ſepulchre of his fathers. He foreſaw, without doubt, all that would happen in conſequence of Huſhai's advice, and was determined to prevent the death which he had deſerved, and which David would probably have inflicted on him, as ſoon as he ſhould be reſettled on his throne.

AHMELLA, in *Botany*. See Bidens, Botany *Index*.

AHOLIBAH and Aholah, are two feigned names made uſe of by Ezekiel (xxiii. 4.) to denote the two kingdoms of Judah and Samaria. Aholah and Aholibah are repreſented as two ſiſters of Egyptian extraction. Aholah ſtands for Samaria, and Aholibah for Jeruſalem. The firſt ſignifies a *tent;* and the ſecond, *my tent is in her*. They both proſtituted themſelves to the Egyptians and Aſſyrians, in imitating their abominations and idolatries; for which reaſon they were abandoned to thoſe very people for whom they had ſhown ſo paſſionate and ſo impure an affection; they were carried into captivity, and reduced to the ſevereſt ſervitude.

AHULL, in the ſea-language, the ſituation of a ſhip when all her ſails are furled on account of the violence of the ſtorm, and when having laſhed her helm on the lee-ſide, ſhe lies nearly with her ſide to the wind and ſea, her head being ſomewhat inclined to the direction of the wind.

AHUN, a town in France, in the Upper Marche and generality of Moulins, in the department of Creuſe. It is ſeated on the river Creuſe, eight miles ſouth-eaſt of Gueret, 30 north-eaſt of Lomages, and 55 ſouth-eaſt of Moulins. E. Long. 1. 52. N. Lat. 49. 5.

AHUYS, a town of Gothland in Sweden. It is ſmall, but very ſtrong by its ſituation, and has a good port. It is in the principality of Gothland, in the territory of Bleckingy, near the Baltic ſea, about 18 miles from Chriſtianſtadt. E. Long, 14. 10. N. Lat. 56. 20.

AI, in *Ancient Geography*, a town in Judea, to the north of Jericho, called Αινα by Joſephus, and the inhabitants *Ainatæ*. Joſhua having ſent a detachment of 3000 men againſt Ai, God permitted them to be repulſed on account of Achan's ſin, who had violated the anathema pronounced againſt the city of Jericho. But after the expiation of this offence, God commanded Joſhua (chap. viii.) to march with the whole army of the Iſraelites againſt Ai, and treat this city and the kingdom thereof as he had treated Jericho, with this difference, that he gave the plunder of the town to the people. Joſhua ſent by night 30,000 men to lie in ambuſh behind Ai; having firſt well inſtructed thoſe who had the command of them in what they were to do; and the next day, early in the morning, he marched againſt the city with the remainder of his army. The king of Ai, perceiving them, ſallied haſtily out of the town with all his people, and fell upon the forces of the Iſraelites, who, upon the firſt onſet, fled, as if they had been under ſome great terror.

As ſoon as Joſhua ſaw the enemy all out of the gates, he raiſed his ſhield upon the top of a pike, which was the ſignal given to the ambuſcade; whereupon they immediately entered the place, which they found without defence, and ſet fire to it. The people of Ai perceiving the ſmoke aſcending, were willing to return, but diſcovered thoſe who had ſet fire to the city in their rear, while Joſhua and thoſe who were with him turning about, fell upon them, and cut them in pieces. The king was taken alive, and afterwards put to death.

The chevalier Folard obſerves, that Joſhua's enterpriſe on Ai, excepting in ſome particulars of military art, is very like that of Gibeah, which is ſcarce any thing more than a copy of it. It would appear, ſays that writer, by the Scripture account, that Joſhua was not the author of the ſtratagem made uſe of by him: for when God directs himſelf to Joſhua, he ſays, "Go up againſt Ai; lay an ambuſcade behind the town; I have delivered the king and the people of it into thine hands:" yet notwithſtanding this, God might leave the whole glory of the invention and execution of it to him, as to a great general. "Joſhua aroſe, (ſays the ſacred author), and all the people of war, to go up againſt Ai (verſe 3.); and Joſhua choſe out 30,000 mighty men of valour, and ſent them away by night." Folard remarks, that there is a manifeſt contradiction between this verſe and the 12th, wherein it is ſaid, that Joſhua choſe out 500 men, whom he ſent to lie in ambuſh, between Bethel and Ai. How is this to be reconciled? Calmet ſays, that Maſius allows but 5000 men for the ambuſcade, and 25,000 for the attack of the city, being perſuaded that an army of 600,000 men could only create confuſion on this occaſion, without any neceſſity for, or advantage in, ſuch numbers: but the generality of interpreters, continues Calmet, acknowledge two bodies to be placed in ambuſcade, both between Bethel and Ai; one of 25,000, and the other of 5000 men.

With regard to the ſignal Joſhua made to that part of his army which lay in ambuſcade, the learned Folard embraces the opinion of the Rabbins, who believe what is called the ſhield to be too ſmall to ſerve for a ſignal: hence they make it to be the ſtaff of one of their colours: from this, our author concludes, that the whole colours were uſed on this occaſion; for in the Aſiatic ſtyle, which is very near the poetic, the part is oftentimes to be taken for the whole.

AJALON, in *Ancient Geography*, a town of the tribe of Dan, one of the Levitical. Another in the tribe of Benjamin, in whoſe valley Joſhua commanded the moon to ſtand ſtill, being then in her decreaſe, and conſequently to be ſeen at the ſame time with the ſun.

AJAN, a coaſt and country of Africa, has the river Quilmanci on the ſouth; the mountains from which that river ſprings, on the weſt; Abyſſinia, or Ethiopia, and the ſtrait of Babelmandel, on the north; and the Eaſtern, or Indian ocean, on the eaſt. The coaſts coast abounds with all necessaries of life, and has plenty of very good horses. The kings of Ajan are often at war with the emperor of the Abyssins; and all the prisoners they take they sell to the merchants of Cambaya, those of Aden, and other Arabs, who come to trade in their harbours, and give them in exchange, coloured cloths, glass-beads, raisins, and dates; for which they also take back, besides slaves, gold and ivory. The whole sea coast, from Zanguebar to the strait of Babelmandel, is called the coast of Ajan; and a considerable part of it is styled the Desert coast.

AJAX, the son of Oileus, was one of the principal generals who went to the siege of Troy. He ravished Cassandra the daughter of Priam, even in the temple of Minerva, where she thought to have found sanctuary. It is said, he made a serpent of 15 feet long so familiar with him, that it ate at his table, and followed him like a dog. The Locrians had a singular veneration for his memory.

Ajax, the son of Telamon, was, next to Achilles, the most valiant general among the Greeks at the siege of Troy. He commanded the troops of Salamis, and performed many great actions, of which we have an account in the Iliad, in *Dictys Cretensis*, and in the 23d book of Ovid's metamorphoses. He was so enraged that the arms of Achilles were adjudged to Ulysses, that he immediately became mad. The Greeks paid great honours to him after his death, and erected a magnificent monument to his memory upon the promontory of Rhetium.

Ajax, in *Antiquity*, a furious kind of dance, in use among the Grecians; intended to represent the madness of that hero after his defeat by Ulysses, to whom the Greeks had given the preference in his contest for Achilles's arms. Lucian, in his treatise of Dancing, speaks of dancing the *Ajax*.—There was also an annual feast called *Ajantia*, Αιαντεια, consecrated to that prince, and observed with great solemnity in the island of Salamis, as well as in Attica: where, in memory of the valour of Ajax, a bier was exposed, set out with a complete set of armour.

AJAZZO, a sea-port of the island of Corsica, in the Mediterranean, with a bishop's see. It is situated in a fertile territory, which produces excellent wines. It has a small citadel; the streets are spacious, the houses well built, and the walks agreeable. The number of inhabitants is computed about 4000; many of them are Greeks. The trade of Ajazzo consists of timber, and black, red, and white coral; in the fishery of which the inhabitants are employed. E. Long. 8. 50. N. Lat. 41. 50.

Ajazzo, a sea-port town of Natolia, in the province of Caramania, anciently Cilicia, seated on the coast of the Mediterranean, 30 miles north of Antioch and 50 west of Aleppo, where the city of Issus anciently stood, and near which Alexander fought his second battle with Darius. E. Long. 33. 10. N. Lat. 37. 0.

AICHSTAT, a town of Germany, in Franconia, and capital of a bishopric of the same name. It is remarkable for a curious piece of workmanship, called the Sun of the Holy Sacrament, which is in the church. It is of massy gold, of great weight; and is enriched with 350 diamonds, 1400 pearls, 250 rubies, and other precious stones. This place is moderately large, and seated in a valley on the river Altmul, 10 miles north of Nieuburg, and 37 south of Nuremberg. E. Long. 11. 10. N. Lat. 49. 0. The bishopric is 45 miles in length and 17 in breadth; and the bishop is chancellor of the church of Mayence or Mentz.

AID, in a general sense, denotes any kind of assistance given by one person to another.

Aid, in *Law*, denotes a petition made in court to call in help from another person who has interest in land, or any thing contested.

Aid-de-Camp, in *Military Affairs*, an officer employed to receive and carry the orders of a general.

Aid, *Auxilium*, in *Ancient Customs*, a subsidy paid by vassals to their lords on certain occasions. Such were the aid of relief, paid upon the death of the lord mesne to his heir; the *aid cheval*, or capital aid, due to the chief lord on several occasions, as, to make his eldest son a knight, to make up a portion for marrying his daughter, &c.

AIDS, in the *French Customs*, were certain duties paid on all goods exported or imported into that kingdom.

Courts of Aids, in France, a sovereign court formerly established in several cities, which had cognizance of all causes relating to the taxes, gabelles, and aids, imposed on several sorts of commodities, especially wine.

Aids, in the *Manege*, are the same with what some writers call *cherishings*, and used to avoid the necessity of corrections.—The inner heel, inner leg, inner rein, &c. are called *inner aids*; as the outer heel, outer leg, outer rein, &c. are called *outer aids*.

AIDAN, a famous Scottish bishop of Lindisfarne, or Holy Island, in the 7th century, was employed by Oswald king of Northumberland in the conversion of the English, in which he was very successful. He was a monk in the monastery of Jona, one of the Hebrides. He died in 651.

AIGHENDALE, the name of a liquid measure used in Lancashire, containing seven quarts.

AIGLE, a bailiwick in the territory of Romand in Switzerland, consists of mountains and valleys, the principal of which are the Aigle and Bex. Through these is the great road from Valais into Italy. When you pass by Villeneuve, which is at the head of the lake of Geneva, you enter into a deep valley three miles wide, bordered on one side with the Alps of Switzerland, and on the other side with those of Savoy, and crossed by the river Rhone. Six miles from thence you meet with Aigle, a large town, seated in a wide part of the valley, where there are vineyards, fields, and meadows. The governor's castle is on an eminence that overlooks the town, and has a lofty marble tower. This government has nine large parishes; and is divided into four parts, Aigle, Bex, Olon, and Ormont. This last is among the mountains, and joins to Rougemont. It is a double valley, abounding in pasture-lands. Ivorna, in the district of Aigle, was in part buried by the fall of a mountain, occasioned by an earthquake in 1584.

Aigle, a small town in France, in Upper Normandy, 23 miles from D'Evereux, and 38 from Rouen, in the department of Orne. It is surrounded with walls and ditches, and has six gates, three suburbs, and three parishes. It trades in corn, toys, and more particularly in needles and pins. E. Long. 1. 5. N. Lat. 48. 35.

AIGUILLON,

AIGUILLON, a ſmall town of France in the province of Guienne, and department of Garonne and Lot, which has a conſiderable trade in wines, brandy, and hemp. E. Long. 0. 22. N. Lat. 44. 25.

AIGUISCE, in *Heraldry*, denotes a croſs with its four ends ſharpened, but ſo as to terminate in obtuſe angles.—It differs from the croſs fitchee, in as much as the latter tapers by degrees to a point, and the former only at the ends.

AIKMAN, William, a painter of conſiderable eminence, was born in Scotland, October 24. 1682. He was the ſon of William Aikman Eſq. of Cairney, and was intended by his father to follow his own profeſſion, which was that of an advocate at the Scotch bar. But the genius of the ſon led him to other ſtudies. He devoted himſelf to the fine arts, eſpecially that of painting, and having for ſome time proſecuted his ſtudies in Britain, in the year 1707 he went to Italy, reſided in Rome for three years, afterwards travelled to Conſtantinople and Smyrna, and in 1712 returned to his own country. About the year 1723 he fixed his reſidence in London, where he followed the profeſſion of painting, and had the good fortune to be patroniſed by the duke of Argyle, the earl of Burlington, Sir Godfrey Kneller, and other liberal encouragers of the arts. He painted many portraits of perſons of the firſt rank in England and Scotland; and a large picture of the royal family for the earl of Burlington, now in the poſſeſſion of the duke of Devonſhire, which was unfiniſhed at his death. Some of his portraits painted in Scotland are in the poſſeſſion of the duke of Argyle, the duke of Hamilton and others. Mr Aikman died in London, June 4. 1731. Six months previous to his death he had loſt a ſon at the age of 17. The remains of both were removed to Edinburgh, and were interred in the Grayfriars church-yard on the ſame day. Mr Somerville the author of the Chace, Mr Mallet, Mr Allan Ramſay the Scottiſh poet, and Mr Thomſon, were among Mr Aikman's intimate acquaintances; and the muſe of each, in elegiac numbers, offered a warm tribute to the memory of their departed friend. The following epitaph from the pen of Mr Mallet, was engraved on his tomb:

> Dear to the good and wiſe, diſprais'd by none,
> Here ſleep in peace the father and the ſon;
> By virtue as by nature cloſe ally'd,
> The painter's genius, but without the pride:
> Worth unambitious, wit afraid to ſhine,
> Honour's clear light, and friendſhip's warmth divine:
> The ſon fair riſing knew too ſhort a date;
> But, oh! how more ſevere the father's fate!
> He ſaw him torn untimely from his ſide,
> Felt all a father's anguiſh—wept and died.

Mr Aikman's ſtile of painting was an imitation of the pleaſing ſimplicity of nature. It is diſtinguiſhed by ſoftneſs of light, mellowneſs of ſhade, and mildneſs and harmony of colouring. His compoſitions have more placid tranquillity of eaſe, than boldneſs of touch and brilliancy of effect. His portraits are ſuppoſed to have ſome reſemblance to thoſe of Kneller, and not only in the imitation of the dreſſes of the time, but in the ſimilarity of tint and manner of working.

AILANA, Ailath, or Aheloth, anciently a town of Arabia Petræa, ſituated near the Sinus Elanites of the Red ſea. It was alſo called *Eliath*, and *Eloth* (Stephanus, Strabo, Moſes). The ſame with *Elana*.

AILANTHUS, in *Botany*. See Botany *Index*.

AILE, in *Law*, a writ which lies where a perſon's grandfather, or great-grandfather, being ſeiſed of lands, &c. in fee-ſimple, the day that he died, and a ſtranger abates and enters the ſame day, and diſpoſſeſſes the heir of his inheritance.

AILESBURY, Aylesbury, or Alesbury, a borough town in Buckinghamſhire, conſiſting of about 400 houſes. The ſtreets lie round the market-place, in the middle of which is a convenient hall, where the ſeſſions are held, and ſometimes the aſſizes for the county. It ſends two members to parliament. It is ſixty miles ſouth-eaſt of Buckingham, and forty-four north-weſt of London. W. Long. 0. 40. N. Lat. 51. 40.

AILMER, or Æthelmare, earl of Cornwall and Devonſhire, in the reign of King Edgar. It is not known of what family he was. His authority and riches were great, and ſo alſo in appearance was his piety. He founded the abbey of Cernel, in Dorſetſhire; and had ſo great a veneration for Eadwald, the brother of St Edmund the Martyr, who had lived a hermit in that country, near the Silver Well, as they called it, that, with the aſſiſtance of Archbiſhop Dunſtan, he tranſlated his relics to the old church of Cernel. In 1016, when Canute, the ſon of Sueno, invaded England, and found himſelf ſtoutly oppoſed by that valiant Saxon prince Edmund Ironſide, the ſon of Æthelred, this Earl Ailmer, with that arch traitor Eadric Streone, earl of Mercia, and Earl Algar, joined the Dane againſt their natural prince, which was one great cauſe of the Saxon's ruin. He did not long ſurvive this; and we find mentioned in hiſtory only one ſon of his, whoſe name was Æthelward, earl of Cornwall, who followed his father's maxims, and was properly rewarded for it. For in 1018, Canute reaping the benefit of their treaſons, and perceiving that the traitors were no longer uſeful, he cauſed the infamous Eadric Streone, and this Earl Æthelward, to be both put to death.

AILRED, or Ealred, abbot of Reveſby in Lincolnſhire, in the reigns of Stephen and Henry II. He was born in 1109, of a noble family, and educated in Scotland with Henry the ſon of King David. On his return to England, he became a monk of the Ciſtertian order, in the monaſtery of Reveſby, of which he afterwards was made abbot. He died on the 12th of January 1166, aged 57, and was buried in his monaſtery. "He was (ſays Leland) in great eſteem during his life; celebrated for the miracles wrought after his death; and admitted into the catalogue of ſaints." He was author of ſeveral works; moſt of which were publiſhed by Gilbo the Jeſuit at Douay, 1631; part of them may be alſo found in the *Bibliotheca Ciſtertienſis*, and *Bibliotheca Patrum*. His principal work is the *Speculum charitatis*. Leland, Bale, and Pits, mention ſeveral manuſcripts which never were publiſhed.

AILSA, an inſulated rock on the weſtern coaſt of Scotland, between the ſhores of Ayrſhire and Cantire. It is two miles in circumference at the baſe, is acceſſible only at one place, and riſes to a great height in a pyramidical form. A few goats and rabbits pick up a ſubſiſtence among the ſhort graſs and furze; but the importance of the rock conſiſts in the great variety and immenſe numbers of birds which frequent it, particularly the gannets or ſolan geeſe, ſome of which are taken for the table, and others for the feathers. The rock is rented from the earl of Caſſilis at 25l. *per annum*. The depth of water around the baſe is from 7 to 48 fathoms. It is ſurrounded with excellent banks, well ſtocked with cod and other white fiſh. On one part of the rock are the remains of an old caſtle, which is ſaid to have been erected by Philip II. of Spain, about the time that the Spaniſh armada invaded Britain.

AINSWORTH, Dr Henry, an eminent nonconformiſt divine, who, about the year 1590, diſtinguiſhed himſelf among the Browniſts; which drew upon him ſuch troubles that he was obliged to retire to Holland, and became miniſter of a church at Amſterdam. His ſkill in the Hebrew language, and his excellent Annotations on the Holy Scriptures, which are ſtill highly eſteemed, gained him great reputation. He alſo wrote ſeveral pieces in defence of the Browniſts, and ſeveral other works.

Ainsworth, *Robert*, born at Woodyale in Lancaſhire in 1660, was maſter of a boarding ſchool at Bethnal green, from whence he removed to Hackney, and to other places in the neighbourhood of London. After acquiring a moderate fortune, he retired, and lived privately till the time of his death, which happened in 1743. We are indebted to his induſtry for a Latin and Engliſh Dictionary, which has been much uſed in ſchools: he publiſhed it in quarto 1736; and in 1752, the fourth edition, under the care of Dr Ward of Greſham College, and the Rev. William Younge, was enlarged to two vols. folio.

AIR, in *Phyſics*, a thin, fluid, elaſtic, tranſparent, ponderous, compreſſible, and dilatable body, ſurrounding the terraqueous globe to a conſiderable height. See Atmosphere, Meteorology, and Pneumatics.

Air, in *Mythology*, was adored by the Heathens under the names of Jupiter and Juno; the former repreſenting the ſuperior and finer part of the atmoſphere, and the latter the inferior and groſſer part. The augurs alſo drew preſages from the clouds, thunder, lightning, &c.

Air, in *Painting*, &c. denotes the manner and very life of action; or it is that which expreſſes the diſpoſition of the agent.—It is ſometimes alſo uſed in a ſynonymous ſenſe with geſture or attitude.

Air, in *Muſic*, is taken in different ſenſes. It is ſometimes contraſted with harmony; and, in this ſenſe, it is ſynonymous with melody in general.—Its proper meaning is, A tune, which is ſet to words, or to ſhort pieces of poetry that are called *ſongs*.

In operas, we give the name of *air* to ſuch pieces of muſic as are formed with meaſures and cadences, to diſtinguiſh it from the recitative; and, in general, every piece of muſic is called an *air*, which is formed for the voice, or even for inſtruments, and adapted to ſtanzas, whether it forms a whole in itſelf, or whether it can be detached from any whole of which it forms a part, and be executed alone.

If the ſubject admits of harmony, and is ſet in parts, the *air* is, according to their number, denominated a *duett*, a *trio*, a *quartetto*, &c. We need not follow Rouſſeau, and the other philologiſts, in their endeavours to inveſtigate the etymon of the word *air*. Its derivation, though found and aſcertained, would contribute little to illuſtrate its meaning in that remote ſenſe, to which, through a long continuance of time, and the various viciſſitudes of language, it has now paſſed. The curious may conſult the ſame article in the *Dictionaire de Muſique* by M. Rouſſeau.

In modern muſic, there are ſeveral different kinds of *airs*, each of which agrees to a certain kind of dancing; and from theſe dances the airs themſelves take their ſpecific names.

The *airs* of our operas are, if we may be permitted the expreſſion, the canvas or ſubſtratum upon which are painted all the pictures of imitative muſic; melody is the deſign, and harmony the colouring; every pictureſque object ſelected from the moſt beautiful parts of nature, every reflected ſentiment of the human heart, are the models which the artiſt imitates; whatever gains attention, whatever intereſts the ſoul, whatever charms the ear, or cauſes emotion in the heart, theſe are the objects of his imitation. An air which delights the ear, and diſcovers the learning of the compoſer; an air invented by genius, and compoſed with taſte; is the nobleſt effort of muſic: it is this which explores the compaſs, and diſplays the delicacy, of a beautiful voice; it is in this where the charms of a well conducted ſymphony ſhine; it is by this, that the paſſions, excited and inflamed by nice gradations, reach and agitate the ſoul through the avenues of external ſenſe. After hearing a beautiful *air*, the mind is acquieſcent and ſerene: the ear is ſatisfied, not diſguſted: it remains impreſſed on the fancy, it becomes a part of our eſſence, we carry it with us, we are able to repeat it at pleaſure: without the ability acquired by habit to breathe a ſingle note of it, we execute it in our imagination in the ſame manner as we heard it upon the theatre: one ſees the ſcene, the actor, the theatre; one hears the accompaniments and the applauſes. The real enthuſiaſt in muſic never forgets the beautiful airs which he has heard; when he chooſes, he cauſes the opera to recommence.

The words to which *airs* are adapted are not always rehearſed in regular ſucceſſion, nor ſpoken in the ſame manner with thoſe of the recitative; and though, in general, they are very ſhort, yet they are interrupted, repeated, tranſpoſed, at the pleaſure of the artiſt. They do not conſtitute a narrative, which once is told over: they either delineate a picture, which it is neceſſary to contemplate in different points of view; or inſpire a ſentiment in which the heart acquieſces with pleaſure, and from which it is neither able nor willing to be diſengaged; and the different phraſes of the *air*, are nothing elſe but different manners of beholding the ſame image. This is the reaſon why the ſubject of an *air* ſhould be one. It is by theſe repetitions properly placed, it is by theſe redoubled efforts, that an impreſſion, which at firſt was not able to move you, at length ſhakes your ſoul, agitates you, tranſports you out of yourſelf: and it is likewiſe upon the ſame principle, that the runnings, as they are called, or thoſe long, mazy, and inarticulated inflections of the voice, in pathetic *airs*, frequently ſeem, though they are not always ſo, improperly placed: for whilſt the heart is affected with a ſentiment exquiſitely moving, it often expreſſes its emotions by inarticulate ſounds, more ſtrongly and ſenſibly than it could do by words themſelves.

The

The form of *airs* is of two kinds. The ſmall airs are often compoſed of two ſtrains, which ought each of them to be ſung twice; but the important airs in operas are frequently in the form of rondeaus.

AIR, in *Geography*. See AYR.

AIR-Bladder, in fiſhes. See COMPARATIVE ANATOMY and ICHTHYOLOGY *Index*.

AIR-Gun, a pneumatic machine for exploding bullets, &c. with great violence. See PNEUMATICS.

AIR-Jacket, a ſort of jacket made of leather, in which are ſeveral bags, or bladders, compoſed of the ſame materials, communicating with each other. Theſe are filled with air through a leather tube, having a braſs ſtop-cock accurately ground at the extremity, by which means the air blown in through the tube is confined in the bladders. The jacket muſt be wet, before the air be blown into the bags, as otherwiſe it will immediately eſcape through the pores of the leather. By the help of theſe bladders, which are placed near the breaſt, the perſon is ſupported in the water, without making the efforts uſed in ſwimming.

AIR-Pipes, an invention for drawing foul air out of ſhips, or any other cloſe places, by means of fire. Theſe pipes were firſt found out by one Mr Sutton, a brewer in London; and from him have got the name of *Sutton's Air-pipes*. The principle on which their operation depends is known to every body, being indeed no other than that air is neceſſary for the ſupport of fire; and, if it has not acceſs from the places moſt adjacent, will not fail to come from thoſe that are more remote. Thus, in a common furnace, the air enters through the aſh-hole; but if this is cloſed up, and a hole made in the ſide of the furnace, the air will ruſh in with great violence through that hole. If a tube of any length whatever be inſerted in this hole, the air will ruſh through the tube into the fire, and of conſequence there will be a continued circulation of air in that place where the extremity of the tube is laid. Mr Sutton's contrivance then, as communicated to the Royal Society by Doctor Mead, amounts to no more than this.—"As, in every ſhip of any bulk, there is already provided a copper or boiling place proportionable to the ſize of the veſſel; it is propoſed to clear the bad air, by means of the fire already uſed under the ſaid coppers or boiling places for the neceſſary uſes of the ſhip.

"It is well known, that under every ſuch copper or boiler, there are placed two holes, ſeparated by a grate; the firſt of which is for the fire, and the other for the aſhes falling from the ſame; and that there is alſo a flue from the fire placed upward, by which the ſmoke of the fire is diſcharged at ſome convenient place of the ſhip.

"It is alſo well known, that the fire once lighted in theſe fire-places, is only preſerved by the conſtant draught of air through the forementioned two holes and flue; and that if the ſaid two holes are cloſely ſtopped up, the fire, though burning ever ſo briſkly before, is immediately put out.

"But if, after ſhutting up the abovementioned holes, another hole be opened, communicating with any other room or airy place, and with the fire; it is clear, the ſaid fire muſt again be raiſed and burn as before, there being a light draught of air through the ſame as there was before the ſtopping up of the firſt holes; this caſe differing only from the former in this, that the air feeding the fire will now be ſupplied from another place.

"It is therefore propoſed, that, in order to clear the holds of ſhips of the bad air therein contained, the two holes above mentioned, the fire-place and aſh-place, be both cloſed up with ſubſtantial and tight iron doors; and that a copper or leaden pipe, of ſufficient ſize, be laid from the hold into the aſh-place, for the draught of air to come in that way to feed the fire. And thus it ſeems plain, from what has been already ſaid, that there will be, from the hold, a conſtant diſcharge of the air therein contained; and conſequently, that that air, ſo diſcharged, muſt be as conſtantly ſupplied by freſh air down the hatches or ſuch other communications as are opened into the hold; whereby the ſame muſt be continually freſhened, and its air rendered more wholeſome and fit for reſpiration.

"And if into this principal pipe ſo laid into the hold, other pipes are let in, communicating reſpectively either with the well or lower decks; it muſt follow, that part of the air, conſumed in feeding the fire, muſt be reſpectively drawn out of all ſuch places to which the communication ſhall be ſo made."

This account is ſo plain, that no doubt can remain concerning the efficacy of the contrivance: it is evident, that, by means of pipes of this kind, a conſtant circulation of freſh air would be occaſioned through thoſe places where it would otherwiſe be moſt apt to ſtagnate and putrefy. Several other contrivances have been uſed for the ſame purpoſe; and Dr Hales's ventilators, by ſome unaccountable prejudice, have been reckoned ſuperior in efficacy and even ſimplicity to Mr Sutton's machine, which at its firſt invention met with great oppoſition, and even when introduced by Dr Mead, who uſed all his intereſt for that purpoſe, was ſhamefully neglected.

A machine capable of anſwering the ſame purpoſe was invented by Mr Deſaguliers, which he called the *ſhip's* lungs. It conſiſted of a cylindrical box ſet up on its edge, and fixed to a wooden pedeſtal. From the upper edge of the box iſſued a ſquare trunk open at the end, and communicating with the cavity of the box. Within this box was placed a cylindrical wheel turning on an axis. It was divided into 12 parts, by means of partitions placed like the radii of a circle. Theſe partitions did not extend quite to the centre, but left an open ſpace of about 18 inches diameter in the middle; towards the circumference, they extended as far as poſſible without interfering with the caſe, ſo that the wheel might always be allowed to turn freely.—Things being thus circumſtanced, it is plain, that if the wheel was turned towards that ſide of the box on which the trunk was, every diviſion would puſh the air before it, and drive it out through the trunk, at the ſame time that freſh air would come in through the open ſpace at the centre, to ſupply that which was thrown out through the trunk. By turning the wheel ſwiftly, a ſtrong blaſt of air would be continually forced out through the ſquare trunk, on the ſame principles on which a common fanner winnows corn. If the wheel is turned the oppoſite way, a draught of air may be produced from the trunk to the centre. If this machine, then, is placed in a room where a circulation of air is wanted, and the trunk made to paſs through one of the walls; by turning the wheel swiftly round, the air will be forced with great velocity out of that room, at the same time that fresh air will enter through any chinks by which it can have access to supply that which has been forced out.

It is evident, that the circulation which is promoted by this machine, is entirely of the same kind with that produced by Mr Sutton's; the turning of the wheel in Mr Desaguliers's machine being equivalent to the rarefaction of the air by fire in Mr Sutton's: but that the latter is vastly superior, as acting of itself, and without intermission, requires no arguments to prove. Mr Sutton's machine has yet another conveniency, of which no other contrivance for the same purpose can boast; namely, that it not only draws out putrid air, but destroys it by causing it pass through fire; and experience has abundantly shown, that though putrid air is thrown into a great quantity of fresh air, it is so far from losing its pernicious properties, that it often produces noxious diseases. We do not say, indeed, that putrid air becomes salutary by this means; but it is undoubtedly rendered less noxious than before; though whether it is equally innocent with the smoke of a fire fed in the common way, we cannot pretend to determine.

Besides this machine by Mr Desaguliers, the ventilators of Dr Hales, already mentioned, and those called *wind-sails*, are likewise used for the same purpose. The former of which is an improvement of the Hessian bellows: the other is a contrivance for throwing fresh air into those places where putrid air is apt to lodge; but this has the last-mentioned inconvenience in a much greater degree than any of the others, as the blast of fresh air throws out that which was rendered putrid by stagnation, in such a manner as to contaminate all around it.

Air-Pump, a machine by which the air contained in a proper vessel may be exhausted or drawn out. See Pneumatics.

Air-Sacs, in *Birds*. See Comparative Anatomy.

Air-Shafts, among *Miners*, denote holes or shafts let down from the open air to meet the adits and furnish fresh air. The damps, deficiency, and impurity of air which occur, when adits are wrought 30 or 40 fathoms long, make it necessary to let down air-shafts, in order to give the air liberty to play through the whole work, and thus discharge bad vapours, and furnish good air for respiration: the expence of which shafts, in regard of their vast depths, hardness of the rock, drawing of water, &c. sometimes equals, nay exceeds, the ordinary charge of the whole adit.

Sir Robert Murray describes a method, used in the coal-mines at Liege, of working mines without air-shafts.

When the miners at Mendip have sunk a groove, they will not be at the charge of an air-shaft till they come at ore; and for the supply of air have boxes of elm exactly closed, of about six inches in the clear, by which they carry it down about twenty fathoms. They cut a trench at a little distance from the top of the groove, covering it with turf and rods disposed to receive the pipe, which they contrive to come in sideways to their groove, four feet from the top; which carries down the air to a great depth. When they come at ore, and need an air-shaft, they sink it four or five fathoms distant, according to the convenience of the breadth, and of the same fashion with the groove, to draw ore as well as air.

Air-Threads, in *Natural History*, a name given to the long filaments, so frequently seen in autumn floating about in the air.

These threads are the work of spiders, especially of that species called the long-legged field-spider; which, having mounted to the summit of a bush or tree, darts from its tail several of these threads, till one is produced capable of supporting the creature in the air: on this it mounts in quest of prey, and frequently rises to a very considerable height. See Aranea.

Air-Trunk, is also a contrivance by Dr. Hales to prevent the stagnation of putrid effluvia in jails, and other places where a great number of people are crowded together in a small space. It consists only of a long square trunk open at both ends; one of which is inserted into the ceiling of the room, the air of which is required to be kept pure; and the other extends a good way beyond the roof. Through this trunk a continued circulation is carried on: and the reason is, that the putrid effluvia which do so much mischief when collected, being much lighter than the pure atmosphere, arise to the top of the room; and, if they there find a vent, will continually go out through it. These effluvia arise in very considerable quantity, being calculated by the late Dr Keil at no less than 39 ounces from one man in 24 hours.

These trunks were first made trial of by Mr Yeoman, over the House of Commons, where they were nine inches wide within; and over the Court of King's Bench in Westminster-hall, where they were six inches wide. They are sometimes made wider, and sometimes narrower: but the wider they are the longer they ought to be, more effectually to promote the ascent of the vapour. The reason why vapours of this kind ascend more swiftly through a long trunk than a short one, is, that the pressure of fluids is always according to their different depth, without regard to the diameter of their basis, or of the vessel which contains them; and, upon this principle, a gallon of water may be made to split a strong cask. See Hydrostatics. When the column of putrid effluvia is long and narrow, the difference between the column of atmosphere pressing on the upper end of the trunk, and that which presses on the lower end, is much greater than if the column of putrid effluvia was short and wide; and consequently the ascent is much swifter.—One pan of a single pair of scales, which was two inches in diameter, being held within one of these trunks over the House of Commons, the force of the ascending air made it rise so as to require four grains to restore the equilibrium, and this when there was no person in the house; but when it was full, no less than 12 grains were requisite to restore the equilibrium; which clearly shows that these trunks must be of real and very great efficacy.

Air-Vessels, are spiral ducts in the leaves, &c. of plants, supposed to be analogous to the lungs of animals, in supplying the different parts of a plant with air. See Botany *Index*.

AIRA, in *Botany*, Hair-grass. See Botany *Index*.

AIRANI, in *Church-history*, an obscure sect of Arians, in the fourth century, who denied the consubstantiality of the Holy Ghost with the Father and the Son. They are otherwise called *Airanistæ*; and are said to have

have taken their name from one *Airos*, who diſtinguiſhed himſelf at the head of this party, in the reigns of Valentinian and Gratian.

AIRE, in *Geography*, an ancient town of France. in the department of Landes, formerly Gaſcony. It is ſeated on the river Adour, on the declivity of a mountain, 155 leagues from Paris. E. Long. 5. 26. N. Lat. 43. 47.

Aire, a ſtrong town in the Netherlands, in the county of Artois, now the department of Pas-de-Calais, with a caſtle. It was taken by the French in 1710, and was confirmed to them by the treaty of Utrecht. It is ſeated on the river Lis, 22 miles ſouth of Dunkirk, and communicates with St Omer's by a canal cut from the river Aa. E. Long. 2. 31. N. Lat. 50. 38.

AIRING, a term peculiarly uſed for the exerciſing horſes in the open air. It purifies the blood; purges the body from groſs humours; and, as the jockies expreſs it, teaches the horſe how to make his wind rake equally, and keep time with the other motions of his body. It alſo ſharpens the ſtomach, and keeps the creature hungry; which is a thing of great conſequence, as hunters and racers are very apt to have their ſtomach fall off, either from want of exerciſe, or from the too violent exerciſe which they are often expoſed to. If the horſe be over fat, it is beſt to air him before ſunriſe and after ſunſetting; and in general, it is allowed by all, that nothing is more beneficial to thoſe creatures than early and late airings. Some of our modern manegers, however, diſpute this; they ſay, that the cold of theſe times is too great for the creature; and that if, in particular, he is ſubject to catarrhs, rheums, or the like complaints, the dews and cold fogs, in theſe early and late airings, will be apt to increaſe all thoſe diſorders. Nature, we ſee, alſo points out the ſun-beams as of great uſe to theſe animals; thoſe which are kept hardy and lie out all night, always running to thoſe places where the ſunſhine comes, as ſoon as it appears in a morning. This ſhould ſeem to recommend thoſe airings that are to be made before ſunſet, and a little time after ſunriſe. As to the caution, ſo earneſtly inculcated by Markham, of uſing theſe early and late airings for fat horſes, it is found unneceſſary by many: for they ſay, that the ſame effect may be produced by airings at warmer times, provided only that they are made longer; and that, in general, it is from long airings that we are to expect to bring a horſe to a perfect wind and ſound courage.

AIRS, in the *Manege*, are the artificial motions of taught horſes; as the demivolt, curvet, capriole, &c.

AIRY, or Aery, among *Sportſmen*, a term expreſſing the neſt of a hawk or eagle.

Airy Triplicity, among *Aſtrologers*, denotes the three ſigns, Gemini, Libra, and Aquarius.

AISNE, a river of France, which riſes in Champagne, and runs weſt by Soiſſons in the Iſle of France, falling into the river Oiſe, a little above Compiegne.

It gives name to one of the five departments which comprehend the ancient Iſle of France, and contains five communal diſtricts.

AITOCZU, a conſiderable river of Leſſer Aſia, which riſes in Mount Taurus, and falls into the ſouth part of the Euxine ſea.

AITON, William, an eminent botaniſt and gardener, was born at a village near Hamilton in Scotland, in 1731. Having been regularly trained to the profeſſion of a gardener, he came into England in the year 1754, and ſoon obtained the notice of the celebrated Philip Miller, then ſuperintendent of the phyſic-garden at Chelſea, who engaged him as an aſſiſtant. His induſtry and abilities recommended him to the princeſs-dowager of Wales as a fit perſon to manage the botanical garden at Kew. In 1759, he was appointed to this office, in which he continued during life, and which was the ſource of his fame and fortune. The garden at Kew, under the auſpices of his preſent majeſty, was deſtined to be the grand repoſitory of all the vegetable riches which could be accumulated, by regal munificence, from reſearches through every quarter of the globe. Theſe treaſures were fortunately committed to the hands of Mr Aiton, whoſe care and ſkill in their cultivation, and intelligence in their arrangement, acquired him high reputation among the lovers of the ſcience, and the particular eſteem of his royal patrons. Under his ſuperintendence, many improvements took place in the plan and edifices of Kew-gardens, which rendered them the principal ſcene of botanical culture in the kingdom. In 1783, his merit was properly rewarded with the lucrative office of managing the pleaſure and kitchen-gardens of Kew, which he was allowed to retain with the botanical department. In 1789, he publiſhed his *Hortus Kewenſis*; or a Catalogue of the Plants cultivated in the Royal Botanic Garden at Kew, in three vols. 8vo. with 13 plates; a work which had been the labour of many years. The number of ſpecies contained in this work amounted to between five and ſix thouſand, many of which had not before been deſcribed. A new and curious article in it relates to the firſt introduction of particular exotics into the Engliſh gardens. The ſyſtem of arrangement adopted is the Linnæan, with improvements, which the advanced ſtate of botanical ſcience required. Mr Aiton with candour and modeſty acknowledges the aſſiſtance he received in this work from the two eminent Swediſh naturaliſts, Dr Solander and Mr Jonas Dryander. Indeed his character was ſuch as ſecured him the friendſhip and good offices of the moſt diſtinguiſhed names in ſcience of his time. He was for many years peculiarly honoured by the notice of Sir Joſeph Banks, the preſident of the Royal Society. The *Hortus Kewenſis* was received with avidity by the botanic world, and a large impreſſion was ſoon diſpoſed of.

Notwithſtanding the ſingular activity and temperance of Mr Aiton, he fell into that incurable malady, a ſchirrous liver, of which he died in 1793, in his ſixty-ſecond year. His eldeſt ſon, devoted to the ſame purſuits, was, by the king's own nomination, appointed to all his father's employments. Mr Aiton's private character was highly eſtimable for mildneſs, benevolence, piety, and every domeſtic and ſocial virtue. He was interred in the churchyard of Kew, amidſt a moſt reſpectable concourſe of friends. (*Gen. Biog.*)

AITONIA, in *Botany*. See Botany *Index*.

AJUGA, Bugle, in *Botany*. See Botany *Index*.

AIUS locutius, the name of a deity to whom the Romans erected an altar. The words are Latin, and ſignify "a ſpeaking voice." The following accident gave occaſion to the Romans erecting an altar to Aius

Aius Locutius. One M. Seditius, a plebeian, acquainted the tribunes, that, in walking the ſtreets by night, he had heard a voice over the temple of Veſta, giving the Romans notice that the Gauls were coming againſt them. This intimation was, however, neglected; but after the truth was confirmed by the event, Camillus acknowledged this voice to be a new deity, and erected an altar to it under the name of *Aius Locutius*.

AJUTAGE, or ADJUTAGE, a kind of tube fitted to the mouth of the veſſel through which the water of a fountain is to be played. To the different form and ſtructure of ajutages is owing the great variety of fountains.

AIX, a ſmall but ancient town in the duchy of Savoy, with the title of a marquiſate. It is ſeated on the lake Bourget, at the foot of a mountain, between Chamberry, Annecy, and Rumilly. There is here a triumphal arch of the ancient Romans, but it is almoſt entirely ruined. The mineral waters bring a great number of ſtrangers to this place. The place was originally called *Aquæ Gratianæ*, from the hot baths built there by the emperor Gratian. E. Long. 5. 48. N. Lat. 45. 40.

AIX, in *Geography*, an ancient city, the capital of the department of the Bouches du Rhone, formerly Provence, in France. This city has an air of ſilence and gloom commonly characteriſtic of places deſtitute of commerce or induſtry. It is, however, well built; and moſt like Paris of any place in the kingdom, as well for the largeneſs of the buildings as in reſpect of the politeneſs of the inhabitants. It is embelliſhed with abundance of fine fountains, and ſeveral beautiful ſquares. The Preachers ſquare is on the ſide of a hill; it is about 160 yards in length, and is ſurrounded with trees, and houſes built with ſtone three ſtories high. The town-hall is at one end of the city, and is diſtributed into ſeveral fine apartments: the two loweſt are taken up by the board of accounts, and by the ſeneſchal; that above is deſigned for the ſeſſions of parliament. The hall of audience is adorned with the pictures of the kings of France on horſeback. The hotel of the city is a handſome building, but hid by the houſes of the narrow ſtreet in which it is placed. The cathedral church is a Gothic ſtructure, with tombs of ſeveral earls of Provence, and ſome good pictures by French maſters. The Corſe, or Orbitelle, is a magnificent walk, above 300 yards long, formed by a triple avenue of elms, and two rows of regular and ſtately houſes. The church of the fathers of the oratory is a handſome building; and not far from thence is the chapel of the blue penitents, which is full of paintings. The convent of preachers is very fine; in their church is a ſilver ſtatue of the Virgin Mary almoſt as big as the life. There are other churches and buildings which contain a great number of rarities. The baths without the city, which were diſcovered not long ſince, have good buildings, raiſed at a vaſt expence, for the accommodation of thoſe who drink the waters. Although Aix was the firſt Roman ſettlement in Gaul, it is not remarkable for ancient remains. The warm ſprings, from which it is now known and frequented, induced Sextus Calvinus to found a colony here, to which he gave the name of *Aquæ Sextiæ*. They were ſuppoſed to poſſeſs particular virtues in caſes of debility; and ſeveral altars have been dug up ſacred to Priapus, the inſcriptions on which indicate their gratitude to that deity for his ſuppoſed ſuccour and aſſiſtance. E. Long. 5. 32. N. Lat. 43. 32.

AIX, a ſmall iſland on the coaſt of France, between the iſle of Oleron and the continent. It is 12 miles north-weſt of Rochfort, and 12 ſouth-ſouth-weſt of Rochelle. W. Long. 1. 4. N. Lat. 46. 5.

AIX-LA-CHAPELLE, a fine city of Germany, in the circle of Weſtphalia and duchy of Juliers, and capital of the department of Roer.

All authors are agreed about its antiquity, it being mentioned in Cæſar's Commentaries and the Annals of Tacitus. The Romans had colonies and fortreſſes there, when they were at war with the Germans; but the mineral waters and the hot bath ſo increaſed its fame, that, in proceſs of time, it was advanced to the privileges of a city, by the name of Aquægranii, that is, the waters of Granius; that which it has now, of *Aix-la-Chapelle*, was given it by the French, to diſtinguiſh it from the other Aix. It is ſo called, on account of a chapel built in honour of the Holy Virgin by Charlemagne; who having repaired, beautified, and enlarged the city, which was deſtroyed by the Huns in the reign of Attila in 451, made it the uſual place of his reſidence. The town is ſeated in a valley ſurrounded with mountains and woods, and yet the air is very wholeſome. It may be divided into the inward and outward city. The inward is encompaſſed with a wall about three quarters of a league in circumference, having ten gates; and the outward wall, in which there are eleven gates, is about a league and a half in circumference. There are rivulets which run through the town and keep it very clean, turning ſeveral mills; beſides 20 public fountains, and many private ones. They have ſtone quarries in the neighbourhood, which furniſh the inhabitants with proper materials for their magnificent buildings, of which the ſtadt-houſe and the cathedral are the chief. There are likewiſe 30 parochial or collegiate churches. The market-place is very ſpacious, and the houſes round it are ſtately. In the middle, before the ſtadt-houſe, is a fountain of blue ſtones, which throws out water, from ſix pipes, into a marble baſon placed beneath, 30 feet in circumference. On the top of this fountain is placed the ſtatue of Charlemagne, of gilt braſs, holding a ſceptre in his right hand, and a globe in his left. The ſtadt-houſe is adorned with the ſtatues of all the emperors ſince Charlemagne. This fabric has three ſtories, the upper of which is one entire room of 160 feet in length and 60 in breadth. In this the new-elected emperor formerly entertained all the electors of the empire.

Aix-la-Chapelle is a free imperial city, and changes its magiſtracy every year on the eve of St John Baptiſt. The mayor is in the nomination of the elector palatine, in the quality of the duke of Juliers, as protector of the city. This place is famous for ſeveral councils and treaties of peace concluded here; particularly thoſe between France and Spain in 1668, and between Great Britain and France in 1748.

The hot ſulphureous waters for which this place has ſo long been celebrated, ariſe from ſeveral ſources, which ſupply eight baths conſtructed in different parts of the town. Theſe waters near the ſources are clear and

and pellucid; and have a ſtrong ſulphureous ſmell reſembling the waſhings of a foul gun; but they loſe this ſmell by expoſure to air. Their taſte is ſaline, bitter, and urinous. They do not contain iron. They are alſo neutral near the fountain, but afterwards are manifeſtly and pretty ſtrongly alkaline, inſomuch that clothes are waſhed with them without ſoap. On the vaults above the ſprings and aqueducts of theſe waters is found, every year, when they are opened, a quantity of fine white-coloured flowers of ſulphur, which has been ſublimed from the waters.

The heat of the water of the hotteſt ſpring, by Dr Lucas's account, raiſes the quickſilver of Fahrenheit's thermometer to 136°—by Monſ. Monet's account, to 146°—and the heat of the fountain, where they commonly drink, by Dr Lucas's account, to 112°.

Dr Simmons has given the following account of their ſeveral temperatures, as repeatedly obſerved by himſelf with a thermometer conſtructed by Nairne.

The ſpring which ſupplies the Emperor's Bath (*Bain de l'Empereur*), the New Bath (*Bain Neuf*), and the Queen of Hungary's Bath (*Bain de la Reine de Hongrie*),	127°
St Quirin's Bath (*Bain de St Quirin*), -	112°
The Roſe bath (*Bain de la Roſe*), and the Poor's Bath (*Bain des Pauvres*), both which are ſupplied by the ſame ſpring.	112°
Charles's Bath (*Bain de Charles*), and St Corneille's Bath (*Bain de St Corneille*), -	112°
The ſpring uſed for drinking is in the High Street, oppoſite to Charles's Bath; the heat of it at the pump is - - - -	106°

Dr Lucas evaporated the water of the hotteſt ſpring (of the Emperor's Bath), and obtained 268 grains of ſolid matter from a gallon, compoſed of 15 grains of calcareous earth, 10 grains of ſelenites, and 243 grains of a ſaline matter made up of natron and ſea-ſalt. They are at firſt nauſeous and harſh, but by habit become familiar and agreeable. At firſt drinking, alſo, they generally affect the head. Their general operation is by ſtool and urine, without griping or diminution of ſtrength; and they alſo promote perſpiration.

The quantity to be drank as an alterative is to be varied according to the conſtitution and other circumſtances of the patient. In general, it is beſt to begin with a quarter or half a pint in the morning, and increaſe the doſe afterwards to a pint, as may be found convenient. The water is beſt drank at the fountain. When it is required to purge, it ſhould be drank in large and often repeated draughts.

In regard to bathing, this alſo muſt be determined by the age, ſex, ſtrength, &c. of the patient, and by the ſeaſon. The degree of heat of the bath ſhould likewiſe be conſidered. The tepid ones are in general the beſt, though there are ſome caſes in which the hotter ones are moſt proper. But even in theſe, it is beſt to begin with the temperate baths, and increaſe the heat gradually.

Theſe waters are efficacious in diſeaſes proceeding from indigeſtion and from foulneſs of the ſtomach and bowels; in rheumatiſms; in the ſcurvy, ſcrophula, and diſeaſes of the ſkin; in hyſteric and hypochondriacal diſorders; in nervous complaints and melancholy; in the ſtone and gravel; in paralytic complaints; in thoſe evils which follow an injudicious uſe of mercury; and in many other caſes. They ought not, however, to be given in hectic caſes where there is heat and fever, in putrid diſorders, or where the blood is diſſolved or the conſtitution much broken down.

The time of drinking, in the firſt ſeaſon, is from the beginning of May to the middle of June; and, in the latter ſeaſon, from the middle of Auguſt to the latter end of September.

There are galleries or piazzas under which the company walk during the time of drinking, in order to promote the operation of the waters.—The Poor's Bath is free for every body, and is frequented by crowds of poor people.

It is ſcarcely neceſſary to add, that there are all kinds of amuſements common to other places of public reſort; but the ſharpers appear more ſplendid here than elſewhere, aſſuming titles, with an equipage ſuitable to them. This city was taken by the French in 1792. They loſt it the year following, but retook it in 1794. Aix-la-Chapelle is 21 miles from Spa, 36 from Liege, and 30 from Cologne. E. Long. 5. 48. N. Lat. 51. 55.

AIZOON, in *Botany*. See Botany *Index*.

AKENSIDE, Mark, a phyſician, who publiſhed in Latin "A Treatiſe upon the Dyſentery," in 1764, and a few pieces in the firſt volume of the "Medical Tranſactions" of the college of phyſicians, printed in 1768; but far better known, and to be diſtinguiſhed chiefly hereafter, as a poet. He was born at Newcaſtle-upon-Tyne, November 9. 1721; and after being educated at the grammar-ſchool in Newcaſtle, was ſent to the univerſities of Edinburgh and Leyden; at which laſt he took his degree of doctor in phyſic. He was afterwards admitted by mandamus to the ſame degree at Cambridge; elected a fellow of the college of phyſicians, and one of the phyſicians at St Thomas's Hoſpital; and, upon the eſtabliſhment of the queen's houſehold, appointed one of the phyſicians to her majeſty.

That Dr Akenſide was able to acquire no other kind of celebrity than that of a ſcholar and a poet, is to be accounted for by the following particulars in his life and conduct, related by Sir John Hawkins.—Mr Dyſon and he were fellow-ſtudents, the one of law and the other of phyſic, at Leyden; where, being of congenial tempers, a friendſhip commenced between them that laſted through their lives. They left the univerſity at the ſame time, and both ſettled in London: Mr Dyſon took to the bar, and being poſſeſſed of a handſome fortune, ſupported his friend while he was endeavouring to make himſelf known as a phyſician; but in a ſhort time, having purchaſed of Mr Hardinge his place of clerk of the houſe of commons, he quitted Weſtminſter-hall; and for the purpoſe of introducing Akenſide to acquaintance in an opulent neighbourhood near the town, bought a houſe at North-End, Hampſtead; where they dwelt together during the ſummer ſeaſon, frequenting the long-room, and all clubs and aſſemblies of the inhabitants.

At theſe meetings, which, as they were not ſelect, muſt be ſuppoſed to have conſiſted of ſuch perſons as uſually meet for the purpoſe of goſſiping, men of wealth, but of ordinary endowments, and able to talk of little elſe than news and the occurrences of the day, Akenſide was for diſplaying thoſe talents which had acquired him the reputation he enjoyed in other companies:

Akenside.

panies: but here they were of little use to him; on the contrary, they tended to engage him in disputes that betrayed him into a contempt of those that differed in opinion from him. It was found out that he was a man of low birth, and a dependent on Mr Dyson; circumstances that furnished those whom he offended with a ground of reproach, which reduced him to the necessity of asserting in terms that he was a gentleman.

Little could be done at Hampstead after matters had proceeded to this extremity: Mr Dyson parted with his villa at North-End, and settled his friend in a small house in Bloomsbury-square; assigning for his support such a part of his income as enabled him to keep a chariot.—In this new situation Akenside used every endeavour to become popular, but defeated them all, by the high opinion he everywhere manifested of himself, and the little condescension he showed to men of inferior endowments; by his love of political controversy, his authoritative censure of the public councils, and his peculiar notions respecting government. In the winter evenings he frequented Tom's coffee-house in Devereux-court, then the resort of some of the most eminent men for learning and ingenuity of the time; with some of whom he was involved in disputes and altercations, chiefly on subjects of literature and politics, which fixed on his character the stamp of haughtiness and self-conceit. Hence many, who admired him for his genius and parts, were shy of his acquaintance.

The value of that precept which exhorts us to live peaceably with all men, or, in other words, to avoid creating enemies, can only be estimated by the reflection on those many amiable qualities against which the neglect of it will preponderate. Akenside was a man of religion and strict virtue; a philosopher, a scholar, and a fine poet. His conversation was of the most delightful kind; learned, instructive, and without any affectation of wit, cheerful and entertaining.

Dr Akenside died of a putrid fever, June 23. 1770; and is buried in the parish-church of St James's, Westminster.

His poems, published soon after his death in 4to and 8vo, consist of "The Pleasures of Imagination," two books of "Odes," a "Hymn to the Naiads," and some "Inscriptions." "The Pleasures of Imagination," his capital work, was first published in 1744; and a very extraordinary production it was from a man who had not reached his 23d year. He was afterwards sensible, however, that it wanted revision and correction; and he went on revising and correcting it for several years: but finding this task to grow upon his hands, and despairing of ever executing it to his own satisfaction, he abandoned the purpose of correcting, and resolved to write the poem over anew upon a somewhat different and enlarged plan. He finished two books of his new poem, a few copies of which were printed for the use of the author and certain friends; of the first book in 1757, of the second in 1765. He finished also a good part of a third book, and an introduction to a fourth; but his most munificent and excellent friend, conceiving all that is executed of the new work, too inconsiderable to supply the place, and supersede the republication of the original poem, and yet too valuable to be withheld from the public, hath caused them both to be inserted in the collection of his poems.

Akiba ‖ Alæ.

AKIBA, a famous rabbin, flourished a little after the destruction of Jerusalem by Titus. He kept the flocks of a rich citizen of Jerusalem till the 40th year of his age, and then devoted himself to study in the academies for 24 years; and was afterwards one of the greatest masters in Israel. According to the Jewish accounts, he had 24,000 scholars. He declared for the impostor Barcochebas, whom he owned for the Messiah; and not only anointed him king, but took upon himself the office of his master of the horse. The troops which the emperor Hadrian sent against the Jews, who under the conduct of this false Messiah had committed horrid massacres, exterminated this faction. Akiba was taken, and put to death with great cruelty. He lived 120 years; and was buried with his wife in a cave upon a mountain not far from Tiberias, and his 24,000 scholars were buried round about him upon the same mountain. It is imagined he invented a suppositititious work under the name of the patriarch Abraham.

AKISSAT, the ancient Thyatira, a city in Natolia, in Asia, situated in a plain 18 miles broad, which produces plenty of cotton and grain. The inhabitants who are reckoned to be about 5000, are said to be all Mahometans. The houses are built of nothing but earth or turf dried in the sun, and are very low and ill contrived: but there are six or seven mosques, which are all of marble. There are remarkable inscriptions on marble in several parts of the town, which are part of the ruins of the ancient Thyatira. It is seated on the river Hermus, 50 miles from Pergamos. E. Long. 28. 30. N. Lat. 38. 50.

AKOND, an officer of justice in Persia, who takes cognizance of the causes of orphans and widows; of contracts, and other civil concerns. He is the head of the school of law, and gives lectures to all the subaltern officers; he has his deputies in all the courts of the kingdom, who, with the second *sadra*, make all contracts.

AL, an Arabic particle prefixed to words, and signifying much the same with the English particle *the*: Thus they say, alkermes, alkoran, &c. *i. e.* the kermes, the koran, &c.

AL, or ALD, a Saxon term frequently prefixed to the names of places, denoting their antiquity; as Aldborough, Aldgate, &c.

ALA, a Latin term properly signifying a wing; from a resemblance to which several other things are called by the same name: Thus,

ALA, is a term used by botanists for the hollow of a stalk, which either the leaf, or the pedicle of the leaf, makes with it; or it is that hollow turning, or sinus, placed between the stalk or branch of a plant and the leaf, whence a new offspring usually issues. Sometimes it is used for those parts of leaves otherwise called *lobes*, or *wings*.

ALÆ (the plural number) is used to signify those petals or leaves of papilionaceous flowers, placed between those others which are called the *vexillum* and *carina*, and which make the top and bottom of the flowers. Instances of flowers of this structure are seen in those of pease and beans, in which the top leaf or petal is the vexillum, the bottom the carina, and the side ones the alæ.

ALÆ is also used for those extremely slender and membranaceous

membranaceous parts of some seeds, which appear as wings placed on them; it likewise signifies those membranaceous expansions running along the stems of some plants, which are therefore called *alated stalks*.

Alæ, in *Anatomy*, a term applied to the lobes of the liver, the cartilages of the nostril, &c.

Alæ, in the *Roman Art of War*, were the two wings or extreme parts of the army drawn up in order of battle.

ALABA, one of the three smallest districts of Biscay in Spain, but pretty fertile in rye, barley, and fruits. There are in it very good mines of iron, and it had formerly the title of a kingdom.

ALABANDA, in *Ancient Geography*, a town of Caria, near the Meander, situated beneath eminences resembling asses with pack-saddles, which gave rise to the jest; and between Amyzo to the west and Stratonice to the east. Under the Romans they enjoyed assizes, or a convention of jurisdiction, by Pliny reckoned the fourth in order; hence the proverb in Stephanus, expressing their happiness. It was built by Alabandus, whom therefore they deemed a god. The people were called *Alabandi*, *Alabandenses*, (Cicero;) and *Alabandeis*, after the Greek manner, in coins of Augustus and Claudius; they were also called *Alabandeni* (Livy).

ALABARCHA, in *Antiquity*, a kind of magistrate among the Jews of Alexandria, whom the emperors allowed them to elect, for the superintendency of their policy, and to decide differences and disputes which arose among them.

ALABASTER, William, an English divine, was born at Hadley in the county of Suffolk. He was one of the doctors of Trinity college in Cambridge; and he attended the earl of Essex as his chaplain in the expedition to Cadiz in the reign of Queen Elizabeth. It is said, that his first resolutions of changing his religion were occasioned by his seeing the pomp of the churches of the Roman communion, and the respect with which the priests seemed to be treated amongst them; and appearing thus to waver in his mind, he soon found persons who took advantage of this disposition of his, and of the complaints which he made of not being advanced according to his deserts in England, in such a manner, that he did not scruple to go over to the Popish religion, as soon as he found that there was no ground to hope for greater encouragement in his own country. However that matter be, he joined himself to the Romish communion, but was disappointed in his expectations. He was soon displeased at this; and he could not reconcile himself to the discipline of that church, which made no consideration of the degrees which he had taken before. It is probable too that he could not approve of the worship of creatures, which Protestants are used to look upon with horror. Upon this he returned to England, in order to resume his former religion. He obtained a prebend in the cathedral of St Paul, and after that the rectory of Therfield in Hertfordshire. He was well skilled in the Hebrew tongue; but he gave a wrong turn to his genius by studying the Cabala, with which he was strangely infatuated. He gave a proof of this in a sermon which he preached upon taking his degree of doctor of divinity at Cambridge. He took for his text the beginning of the first book of Chronicles, Adam, Seth, Enos; and having touched upon the literal sense, he turned immediately to the mystical, asserting, that Adam signified misfortune and misery, and so of the rest. His verses were greatly esteemed. He wrote a Latin tragedy intitled *Roxana*; which, when it was acted in a college at Cambridge, was attended with a very remarkable accident. There was a lady who was so terrified at the last word of the tragedy, *Sequar, Sequar*, which was pronounced with a very shocking tone, that she lost her senses all her lifetime after. He died in the year 1640. His *Apparatus in Revelationem Jesu Christi* was printed at Antwerp in 1607. His *Spiraculum tubarum, seu fons Spiritualium Expositionum ex æquivocis Pentaglotti significationibus*, and his *Ecce Sponsus venit, seu tuba pulchritudinis, hoc est demonstratio quod non sit illicitum nec impossibile computare durationem mundi et tempus secundi adventus Christi*, were printed at London. From these titles we may judge what were the taste and genius of the author.

Alabaster, in *Natural History*, a mineral substance whose base is calcareous earth. It differs from marble in being combined, not with the carbonic, but with the sulphuric acid. See Chemistry, and Mineralogy *Index*.

Alabaster, in *Antiquity*, a term used for a vase wherein odoriferous liquors were anciently put. The reason of the denomination is, that vessels for this purpose were frequently made of the alabaster stone, which Pliny and other ancients represent as peculiarly proper for this purpose. Several critics will have the box mentioned in the Gospels as made of alabaster to have been of glass: And though the texts say that the woman broke it, yet the pieces seem miraculously to have been united, since we are told the entire box was purchased by the emperor Constantine, and preserved as a relic of great price. Others will have it, that the name *alabaster* denotes the form rather than the matter of this box: In this view they define alabaster by a box without a handle, deriving the word from the privative α, and λαβη, *ansa, handle*.

Alabaster, is also said to have been used for an ancient liquid measure, containing ten ounces of wine, or nine of oil. In this sense, the alabaster was equal to half the sextary.

ALABASTRUM dendroide, a kind of laminated alabaster, beautifully variegated with the figures of shrubs, trees, &c. found in great abundance in the province of Hohenstein.

ALADINISTS, a sect among the Mahometans, answering to freethinkers among us.

ALADULIA, a considerable province of Turkey in Asia, in that part called Natolia, between the mountains of Antitaurus, which separate it from Amasia on the north, and from Carimania on the west. It has the Mediterranean sea on the south; and the Euphrates, or Frat, on the east, which divides it from Diarbeker. It comprehends the Lesser Armenia of the ancients, and the east part of Cilicia. Formerly it had kings of its own; but the head of the last king was cut off by Selim I. emperor of the Turks, who had conquered the country. It is now divided into two parts: the north, comprehended between Taurus, Antitaurus, and the Euphrates, is a beglerbeglic, which bears the name of Marash, the capital town; and the south, seated between Mount Taurus and the Mediterranean, is united to the beglerbeglic of Aleppo. The country is rough, rugged, and mountainous; yet there are good pastures, and plenty of horses and camels. The people are hardy and thievish. The capital is Malatigah.

ALAIN, Chartier, secretary to Charles VII. king of France, born in the year 1386. He was the author of several works in prose and verse; but his most famous performance was his Chronicle of King Charles VII. Bernard de Girard, in his preface to the History of France, styles him "an excellent historian, who has given an account of all the affairs, particulars, ceremonies, speeches, answers, and circumstances, at which he was present himself, or had information of." Giles Coroxet tells us, that Margaret, daughter to the king of Scotland, and wife to the dauphin, passing once through a hall where Alain lay asleep, she stopped and kissed him before all the company who attended: some of them telling her, that it was strange she should kiss a man who had so few charms in his person, she replied, "I did not kiss the man, but the mouth from whence proceed so many excellent sayings, so many wise discourses, and so many elegant expressions." Mr Fontenelle, among his Dialogues of the Dead, has one upon this incident, between the princess Margaret and Plato. Mr Pasquier compares Alain to Seneca, on account of the great number of beautiful sentences interspersed throughout his writings.

ALAIS, a considerable town of France, in the department of Gard, and formerly the province of Languedoc, situated on the river Gard, at the foot of the Cevennes. The Jesuits had a college in this place; and a fort was built here in 1689. It is 34 miles north of Montpelier, and 340 from Paris. E. Long. 4. 20. N. Lat. 44. 8.

ALAMAGAN, in *Geography*, one of the Ladrone or Marianne islands, in the Indian ocean, is situated in N. Lat. 18. 5. and E. Long. 146. 47. It is of an irregular form, and about 12 miles in circumference. The land in some places of this island is pretty high, so that it may be seen at the distance of 12 or 14 leagues. Near the north end of the island there is a volcano which emitted an immense body of smoke in the year 1799, when it was visited by Captain Bass. The volcano is in a mountain close to the sea, rising above its level 1200 or 1500 feet. The high parts of the island are rugged and sterile. In the lower parts there is a profusion and luxuriance of vegetation. They abound with cocoa-nut trees, several kinds of stone fruit, and the mellora or bread-tree of the Nicobar islands. Some small sugar canes, some banana trees, and one bread-fruit tree were discovered. Lizards, land-crabs, large partridges, quails, pigeons, owls, thrushes, and bullfinches, are numerous. But no fresh water, which was the object of Captain Bass's visit, could be found.

ALAMANDUS, Lewis, in French *Aleman*, archbishop of Arles, and cardinal of St Cecilia, was one of the greatest men of the fifteenth century. The cardinal presided in the council of Basil, which deposed Eugenius IV. and elected the antipope Felix V. He is much commended by Æneas Sylvius, as a man extremely well formed for presiding in such assemblies, firm and vigorous, illustrious by his virtue, learned, and of an admirable memory in recapitulating all that the orators and disputants had said. One day, when he harangued against the superiority of the pope over the council, he distinguished himself in such an eminent manner, that several persons went to kiss him, while others pressed even to kiss his robe. They extolled to the skies his abilities and genius, which had raised him, though a Frenchman, to a superiority over the Italians, notwithstanding all their natural subtlety and finesse. There is no need of asking, whether Pope Eugenius thundered against the president of a council which deposed him. He deprived him of all his dignities, and treated him as a son of iniquity. However, notwithstanding this, Lewis Alamandus died in the odour of sanctity, and performed so many miracles after his death, that at the request of the canons and Celestine monks of Avignon, and the solicitation of the cardinal of Clermont, legate *à latere* of Clement VII. he was beatified by the pope in the year 1527.

ALAMANNI, Lewis, was born at Florence, of a noble family, on the 28th of October 1495. He was obliged to fly his country for a conspiracy against Julius de Medici, who was soon after chosen pope under the name of Clement VII. During this voluntary banishment, he went into France; where Francis I. from a love to his genius and merit, became his patron. This prince employed him in several important affairs, and honoured him with the collar of the order of St Michael. About the year 1540, he was admitted a member of the Inflammati, an academy newly erected at Padua, chiefly by Daniel Barbaro and Ugolin Martelli. After the death of Francis, Henry duke of Orleans, who succeeded him in 1537, showed no less favour to Alamanni; and in the year 1551, sent him as his ambassador to Genoa: this was his last journey to Italy; and being returned to France, he died at Amboise on the 18th of April 1556, being in the 61st year of his age. He left many beautiful poems, and other valuable performances, in the Italian language. We have also some notes of his upon Homer's Iliad and Odyssey; those upon the Iliad were printed in the Cambridge edition of Homer in 1689, and Joshua Barnes has also inserted them in his fine edition of Homer in 1711.

ALAMODALITY, in a general sense, is the accommodating a person's behaviour, dress, and actions, to the prevailing taste of the country or times in which he lives.

Alamodality of writing, is defined the accommodation of mental productions, both as to the choice of subject and the manner of treating it, to the genius or taste of the times, in order to render them more acceptable to the readers.

ALAMODE, a phrase originally French, importing a thing to be in the fashion or mode. The phrase has been adopted not only into several of the living languages, as the English and High-Dutch, but some have even taken it into the Latin. Hence we meet with *Alamodicus* and *Alamodalitas*.

Alamode, in *Commerce*, a thin glossy black silk, chiefly used for women's hoods and men's mourning scarfs.

ALAMOS, Balthasar, a Spanish writer, born at Medina del Campo in Castile. After having studied the law at Salamanca, he entered into the service of Anthony Perez, secretary of state under Philip II. He was in high esteem and confidence with his master, upon which account he was imprisoned after the disgrace of of this minifter. He was kept in confinement 11 years, when Philip III. coming to the throne, fet him at liberty, according to the orders given by his father in his will. Alamos continued in a private capacity, till the duke of Olivarez, the favourite of Philip IV. called him to public employments. He was a man of wit as well as judgment, but his pen was fuperior to his tongue. He died in the 88th year of his age. His Spanifh tranflation of Tacitus, and the aphorifms which he added in the margin, gained him great reputation. This work was publifhed at Madrid in 1614; and was to have been followed, as mentioned in the king's privilege, with a commentary, which however has never yet appeared. The author compofed the whole during his imprifonment.

ALAN, Cardinal William, was born at Roffal in Lancafhire, in the year 1532, He went to Oxford at the age of 15, and in 1550 was elected fellow of Oriel college. In 1556, being then only 24 years old, he was chofen principal of St Mary's hall, and one of the proctors of the univerfity. In 1558 he was made canon of York; but, upon Queen Elizabeth's acceffion to the throne, he left England, and fettled at Louvain in an Englifh college, of which he became the chief fupport. In 1565 he vifited his native country; but, on account of his extreme activity in the propagation of the Roman Catholic religion, he was obliged to fly the kingdom in 1568. He went firft to Mechlin, and then to Douay, where he was made doctor of divinity. Soon after, he was appointed canon of Cambray, and then canon of Rheims. He was created cardinal on the 28th of July 1587, by the title of *St Martin in Montibus;* and obtained from the king of Spain a rich abbey in the kingdom of Naples, and afterwards the bifhoprick of Mechlin. It is fuppofed to have been by the advice and inftigation of this prieft, that Philip II. attempted to invade England. He died on the 20th of October 1594, aged 63; and was buried in the Englifh college at Rome. He was a man of confiderable learning, and an elegant writer. He wrote many books in defence of the Romifh religion. The moft remarkable are, 1. *A defence of the 12 martyrs in one year*. Tho. Alfield was hanged for bringing, and publifhing, this and other of Alan's works, into England, in the year 1584. 2. *A declaration of the fentence of Sextus V.* &c. A work intended to explain the pope's bull for the excommunication of Queen Elizabeth, and to exhort the people of England to take up arms in favour of the Spaniards. Many thoufand copies of this book, printed at Antwerp, were put on board the Armada; but the enterprife failing, they were afterwards deftroyed. 3. *Of the worfhip due to faints and their relicks* 1583. This treatife was anfwered by Lord Burleigh, and is efteemed the moft elegant of the cardinal's writings.

ALAND, in *Geography*, with its dependant iflands, to the number of eighty, is fituated between the gulfs of Bothnia and Finland. Thefe iflands lie between N. Lat. 59. 47. and 60. 30. and between E. Long. 19. 17. and 22. 7. Aland conftitutes the fmalleft of the poffeffions belonging to the crown of Sweden. It contains about feventy-feven fquare Englifh miles, and is in length about twenty Englifh miles, and fixteen in breadth.

Aland has been fuppofed anciently to have been governed by its own monarchs; it is certain, however, that fince the fourteenth century it has made part of the bifhoprick and government of Abo, with the exception that in the year 1743 Aland and the other iflands fubmitted to Ruffia, and fwore allegiance to the czarina, but were foon after reftored to Sweden by the treaty of Abo. Thefe iflands in former times frequently fuffered from the invafions of the Ruffians, and the inhabitants had been forced to fly from their houfes and fertile plains. But in 1718 a congrefs was held here for the reftoration of peace, by which the enjoyment of tranquillity was fecured to them.

Aland and the feveral ifles contain eight parifhes, each of which has a church; and befides thefe places of worfhip, there are feven chapels.

The Laplanders and Fins were undoubtedly the earlieft inhabitants of thefe iflands, and their refidence here is plainly to be traced in the names of places which ftill remain.

Several lakes are met with in thefe iflands, and but one rivulet, which however is fufficient to work two mills, one of which is a faw-mill. The mountains are numerous; the higheft of them is called Ulfdubs Klint.

The revenues which the crown of Sweden receives from Aland and the other iflands, amount annually to nineteen thoufand nine hundred and eighty-fix rix-dollars. Two hundred and ninety-eight failors are regiftered in thefe iflands, which coft the king of Sweden about five thoufand rix-dollars yearly.

Aland contains about three thoufand feven hundred and fifty acres of land in cultivation, which produce rye, wheat, oats, and barley, in the proportion of feven for one. The annual growth of wheat is about twenty-two thoufand five hundred barrels. There is one parifh which has no arable land, and in this refpect refembles Lapland. The inhabitants of this parifh employ themfelves in fifhing, and purchafe all the corn they have occafion for of their neighbours. They catch vaft numbers of pilchards, of which they make great profit, it being the chief traffic of thefe iflands.

It has been in agitation to build a city in the ifle of Aland, but the project has not hitherto been carried into execution, owing it is faid, to the difficulty of chufing a proper fpot for it.

The ufual route from Sweden to Finland is from the poft office of Griflehamn in Upland, which is eleven and a half Swedifh miles, to Eckero in Aland; and from that place acrofs the ifland to Abo, which is five miles more. A Swedifh mile makes between fix and feven Englifh miles.

In the year 1792 the number of inhabitants upon the ifland of Aland amounted to eleven thoufand two hundred and fixty, which is upwards of a thoufand to every fquare Swedifh mile; a very great number when it is confidered how mountainous the ifland is. The inhabitants of thefe iflands live to very great ages. From the year 1692 to the prefent time, nine perfons are recorded to have died at the great age of one hundred years; and perhaps the number had been found greater, had it been thought worth while to notice this particular. In 1703 there died a woman named Anna Berg, who was one hundred and nine years old: and at Kumblinge, in the year 1766, another perfon of the fame fex died at an age of upwards of one hundred and twenty years. One fixth part of the inhabitants are above fifty years old;

old; a circumstance which affords a convincing proof of the healthiness of the place.

The sea which surrounds the isle of Aland is very seldom frozen, and was less so formerly than at the present time. In 1546 it was remarked as an extraordinary event, that in that year the sea was so frozen as to be crossed on the ice. It seems latterly that these severe frosts happened once in ten years. The winter of the year 1702 was remarkably mild, so that barley was sown on the twenty-fifth of March, at which time there was plenty of pasture for cattle: considering its high latitude, Aland enjoys a very favourable climate.

In their manners and customs the inhabitants of Aland do not differ greatly from the peasants of Upland. Their marriages and funerals are celebrated much in the same manner.

The Alanders commonly use nourishing food; their bread is generally made of rye, even when the crops of that kind of corn have proved unfavourable. Fresh fish, and fish dried or salted, together with milk, butter, cheese, and flesh-meat, are their usual fare. They make use of the flesh of seals, and prepare a dish called *skalkroppe*, composed of collops of the flesh mixed up with flour and lard, and this they reckon excellent. In their voyages by sea they lay in a good stock of provisions, and at those times are not sparing of meat and butter.

The dress of the Alanders is becoming. The men wear, in general, short jackets which on holidays are commonly of blue cloth. The young peasants commonly wear cotton stockings, and many of them have even watches. The women, when full dressed, wear a petticoat and apron of camlet, cotton, or printed linen, and sometimes of silk. Their dress in mourning is generally of black silk, with a camlet petticoat.

The dwellings of the peasants are very neat and convenient, kept in good repair, and well lighted. They are usually built of wood, fir, or deal, and covered with the bark of the birch tree, or shingles. Their out-houses are mostly thatched. As they have no running streams and water-mills, scarcely any peasant is without a windmill.

The Alanders are an ingenious, lively, and courteous people; and on the sea display a great degree of skill and resolution. They are far from being superstitious, but are said to be of a litigious disposition.

No bears or squirrels are to be found in these islands; and the elk, which formerly was uncommonly numerous, is now no longer seen in them. The animals chiefly found are wolves, (which are said to cross the sea from Finland, when it has happened to be frozen over) foxes, martens, hares, ermines, bats, moles, rats, mice, &c.; otters are but rarely met with: on the coast are found seals, &c. Above a hundred species of birds are found in the islands. Fish are in great abundance. The number of insects amounts to eight hundred species, some of which are extremely destructive to trees and newly built houses. The mountains are chiefly formed of red granite. (*Acerbi's Travels.*)

ALARAF, in the *Mahometan Theology*, the partition wall that separates heaven from hell. The word is plural, and properly written *al araf*; in the singular it is written *al arf*. It is derived from the Arabic verb *arafa*, to distinguish. Alaraf gives the denomination to the seventh chapter of the Alcoran, wherein mention is made of this wall. Mahomet seems to have copied his Alaraf, either from the great gulf of separation mentioned in the New Testament, or from the Jewish writers, who also speak of a thin wall dividing heaven from hell. Mahometan writers differ extremely as to the persons who are to be found on Alaraf. Some take it for a sort of limbus for the patriarchs, prophets, &c. others place here such whose good and evil works so exactly balance each other, that they deserve neither reward nor punishment. Others imagine this intermediate space to be possessed by those who, going to war without their parents leave, and suffering martyrdom there, are excluded paradise for their disobedience, yet escape hell because they are martyrs.

ALARBES, a name given to those Arabians who live in tents, and distinguish themselves by their dress from the others who live in towns.

ALARES, in *Roman Antiquity*, an epithet given to the cavalry, on account of their being placed in the two wings of the army.

ALARIC, a famous general of the Goths. He entered Thrace at the head of 200,000 men, and laid waste all the country through which he passed. He marched next to Macedonia and Thessaly: The Thessalians met him near the mouth of the river Peneus, and killed about 3000 of his army; nevertheless he advanced into Greece, and after having ravaged the whole country, returned to Epirus, loaded with immense spoils. After staying here five years, he resolved to turn his arms to the west. He marched through Pannonia; and, finding little resistance, entered Italy, in the consulship of Stilicho and Aurelianus, A. D. 400. After various battles and treaties, he at last took Rome by treachery, and permitted his soldiers to plunder it; this happened A. D. 409. Alaric, having laid waste a great part of Italy, intended to pass into Sicily: but a storm obliging him to land again, he besieged the city of Cosenza; and having taken it, he died there in 411, eleven years after he first entered Italy.

ALARM, in the *Military Art*, denotes either the apprehension of being suddenly attacked; or the notice thereof, signified by firing a cannon, firelock, or the like. False alarms are frequently made use of, to harass the enemy, by keeping them constantly under arms. Sometimes also this method is taken to try the vigilance of the piquet-guard, and what might be expected from them in case of real danger.

Alarm-Bell, that rung upon any sudden emergency, as a fire, mutiny, or the like.

Alarm-Post, or *Alarm-place*, the ground for drawing up each regiment in case of an alarm. This is otherwise called *the rendezvous*.

Alarm, in *Fencing*, is the same with what is otherwise called an appeal, or challenge.

ALASCANI, in *Church History*, a sect of Antilutherans, whose distinguishing tenet, besides their denying baptism, is said to have been this, that the words, *This is my body*, in the institution of the eucharist, are not to be understood of the bread, but of the whole action, or celebration of the supper. They are said to have taken the name from one Joannes Alasco, a Polish baron, superintendant of the church of that country, in England. See the next article.

ALASCO, John, a Polish nobleman of the 16th century,

century, who, imbibing the reformed opinions, was expelled his country, and became preacher to a Proteſtant congregation at Embden; but foreſeeing perſecution there, came to England about the year 1551, while the reformation was carrying on under Edward the VI. The publication of the Interim driving the Proteſtants to ſuch places as afforded them toleration, 380 were naturalized here, and obtained a charter of incorporation, by which they were erected into an eccleſiaſtical eſtabliſhment, independent on the church of England. The Auguſtine friars church was granted them, with the revenues, for the maintenance of Alaſco as ſuperintendant, with four aſſiſtant miniſters, who were to be approved by the king: and this congregation lived undiſturbed until the acceſſion of Queen Mary, when they were all ſent away. They were kindly received and permitted to ſettle at Embden; and Alaſco at laſt, after an abſence of 20 years, by the favour of Sigiſmund, returned to his own country, where he died in 1560. Alaſco was much eſteemed by Eraſmus, and the hiſtorians of his time ſpeak greatly in his praiſe: we have of his writing, *De Cœna Domini liber; Epiſtola continens Summam Controverſiæ de Cœna Domini, &c.* He had ſome particular tenets; and his followers are called *Alaſcani* in church-hiſtory.

ALATAMAHA, a large river of North America, which, riſing in the Apalachian mountains, runs ſouth-eaſt through the province of Georgia, and falls into the Atlantic ocean, below the town of Frederica.

ALATERNUS, in *Botany*, the trivial name of a ſpecies of the rhamnus. See RHAMNUS, BOTANY *Index*.

ALAVA, a diſtrict of Spain, about 20 miles in length, and 17 in breadth, containing very good iron mines. Victoria is the capital town.

ALAUDA, or LARK, ſee ORNITHOLOGY *Index*.

ALAUTA, a conſiderable river of Turkey in Europe, which, after watering the north-eaſt part of Tranſylvania and part of Wallachia, falls into the Danube almoſt oppoſite to Nicopolis.

ALAY, ſignifying in the Turkiſh language "The Triumph," a ceremony which accompanies the aſſembling together the forces of that vaſt empire upon the breaking out of a war. It conſiſts of the moſt inſipid buffoonery, and is attended with acts of the moſt ſhocking barbarity. That which took place upon occaſion of the late war between the Porte and Ruſſia is deſcribed by Baron Tott in his Memoirs as follows:

"It conſiſts in a kind of maſquerade, in which each trade ſucceſſively preſents to the ſpectators the mechanical exerciſe of its reſpective art. The labourer draws his plough, the weaver handles his ſhuttle, the joiner his plane; and theſe different characters, ſeated in cars richly ornamented, commence the proceſſion, and precede the ſtandard of Mahomet, when it is brought out of the ſeraglio to be carried to the army, in order to inſure victory to the Ottoman troops.

"This banner of the Turks, which they name *Sandjak-Cheriff*, or The Standard of the Prophet, is ſo revered among them, that, notwithſtanding its reputation has been ſo often tarniſhed, it ſtill retains their implicit confidence, and is the ſacred ſignal unto which they rally. Every thing proclaims its ſanctity. None but the emirs are allowed to touch it; they are its guards, and it is carried by their chief. The Muſſulmans alone are permitted to look upon it. If touched by other hands, it would be defiled; if ſeen by other eyes, profaned. In ſhort, it is encompaſſed by the moſt barbarous fanaticiſm.

"A long peace had unfortunately cauſed the ridiculouſneſs, and eſpecially the danger, of this ceremony to be forgotten. The Chriſtians imprudently crowded to ſee it; and the Turks, who, by the ſituation of their houſes, could make money of their windows, began to profit by the advantage; when an emir, who preceded the banner, proclaimed with a loud voice, 'Let no infidel dare to profane with his preſence the holy ſtandard of the prophet; and let every Muſſulman who perceives an unbeliever make it known under pain of reprobation.'

"From that moment no aſylum was to be found; even thoſe became informers, who, by letting out their houſes, had rendered themſelves accomplices in the crime. A religious fury ſeized on every mind, and put arms in every hand; the more atrocious the cruelty, the more was it meritorious. No regard was paid to ſex or age; pregnant women, dragged by the hair, and trodden under feet by the multitude, periſhed in the moſt deplorable manner. Nothing was reſpected by theſe monſters; and under ſuch auſpices the Turks commenced the war."

ALB, or ALBE, in the *Romiſh Church*, a veſtment of white linen hanging down to the feet, and anſwering to the ſurplice of the Engliſh clergy. In the ancient church, it was uſual, with thoſe newly baptized, to wear an alb, or white veſtment; and hence the Sunday after Eaſter was called *dominica in albis*, on account of the albs worn by thoſe baptized on Eaſter-day.

ALB, is alſo a name of a Turkiſh coin, otherwiſe called *aſper*. See ASPER.

ALBA, in *Ancient Geography*, a town of the Marſi in Italy, ſituated on the north ſide of the Lacus Fucinus, ſtill retaining its name. It ſtands upon an eminence, and is noted in Roman hiſtory for being the ſtate priſon where captive prices were ſhut up, after being barbarouſly dragged through the ſtreets of Rome at the chariot wheels of a triumphant conſul. Perſeus king of Macedon terminated his wretched career in this confinement, with his ſon, the laſt hope of an illuſtrious line of kings. Syphax the Numidian, and Bituinus king of the Averni, were alſo condemned to this gaol by the particular clemency of the ſenate, which ſometimes indulged its ſavage diſpoſition by putting its captives to death.

Alba being ſituated in the centre of Italy, amidſt difficult mountainous paſſes, and far from all means of eſcape, was eſteemed a moſt proper place for the purpoſe of guarding priſoners of importance. Artificial ſtrength was added to its natural ſecurity by fortifications, which remain to this day in a ſtate that proves their ancient ſolidity. For the entertainment of the garriſon, which was required in a place of ſuch conſequence, an amphitheatre was erected, of which the ruins are ſtill valuable, as well as the foundations of a temple, and other buildings of Roman times.

Lucius Vitellius, brother to the emperor of that name, had a villa near this place, famous for the variety and excellence of its fruit trees, which he had brought from Syria. His gardens were the nurſeries where ſeveral of the moſt delicious ſtone-fruits, that are now ſo common in Europe, were first cultivated and multiplied. It must have been necessary at Alba to shelter trees transplanted from Asia, and to treat them with great tenderness and care, in order to rear them to perfection: for the climate of this high region is extremely rigorous in winter; the cold season lasts long, and is accompanied with violent storms of wind and falls of snow. The lake has been often frozen entirely over.

Alba Firma, or *Album*, in our *Old Customs*, denoted rent paid in silver, and not in corn, which was called *black-mail*.

Alba Terra, one of the numerous names for the philosopher's stone.

Alba Regalis. See Stuhl Weissenburgh.

Alba Helviorum, or *Albaugusta*, in *Ancient Geography*, afterwards called *Vivarium*, now *Viviers*, in the south-east of Languedoc, on the Rhone. In the lower age the inhabitants were called *Albenses*, and their city *Civitas Albensium*, in the Notitia Galliæ. E. Long. 4. 45. Lat. 44. 50.

Alba Julia, in *Ancient Geography*, now *Weissenburg*, a town of Transylvania, on the river Marisius, or Merisch, to the west of Hermanstat, supposed to be called *Alba Julia*, after Julia Domna the mother of Caracalla. There are, however, several inscriptions found at or near Weissenburg, which bear Col. Apul, that is *Colonia Apulensis*, without the least mention of *Alba Julia*, though inscribed after Caracalla's time. Add, that Ulpian, reciting the colonies of Dacia, calls this colony *Apulensis*, and neither *Alba* nor *Julia*. Whence there is a suspicion, that *Alba Julia* is a corruption of *Apulum*. It was also called *Apulum Augustum*. E. Long. 25. 0. Lat. 46. 46.

Alba Longa, in *Ancient Geography*, a colony from Lavinum, in Latium, established by Ascanius the son of Æneas, at the foot of the Mons Albanus: called *Alba*, from a white sow found by Æneas, which farrowed 30 white pigs on that spot; which circumstance was interpreted to portend the building of a city there in 30 years after (Propertius). The epithet *Longa* was added on account of its length. It was the royal residence till the building of Rome, as was foretold by Anchises (Virgil); was destroyed by Tullius Hostilius, all but the fane or temple; and the inhabitants were transplanted to Rome (Strabo).

Alba Pompeia, in *Ancient Geography*, on the river Ceba, now *Ceva*, in Liguria, the birth-place of the emperor Pertinax; a colony either established at first by Pompey, or re-established by him after having been before settled by Scipio. The inhabitants were called *Albenses Pompeiani*. At this day the town is simply called *Alba*, without any epithet.

ALBAHURIM, *figura sexdecim laterum*, a figure of great importance according to astrological physicians, who built their prognostics on it.

ALBAN, St, is said to have been the first person who suffered martyrdom for Christianity in Britain; he is therefore usually styled the protomartyr of this island. He was born at Verulam, and flourished towards the end of the third century. In his youth he took a journey to Rome, in company with Amphibalus a monk of Caerleon, and served seven years as a soldier under the emperor Dioclesian. At his return home, he settled in Verulam; and, through the example and instructions of Amphibalus, renounced the er-

rors of Paganism, in which he had been educated, and became a convert to the Christian religion. It is generally agreed, that Alban suffered martyrdom during the great persecution under the reign of Dioclesian; but authors differ as to the year when it happened: Bede and others fix it in 286; some refer it to the year 296; but Usher reckons it amongst the events of 303. The story and circumstances relating to his martyrdom, according to Bede, are as follows. Being yet a Pagan (or at least it not being known that he was a Christian), he entertained Amphibalus in his house. The Roman governor being informed thereof, sent a party of soldiers to apprehend Amphibalus; but Alban, putting on the habit of his guest, presented himself in his stead, and was carried before that magistrate. The governor having asked him of what family he was? Alban replied, "To what purpose do you inquire of my family? if you would know my religion, I am a Christian." Then being asked his name, he answered. "My name is Alban; and I worship the only true and living God, who created all things." The magistrate replied, "If you would enjoy the happiness of eternal life, delay not to sacrifice to the great gods." Alban answered, "The sacrifices you offer are made to devils; neither can they help the needy, or grant the petitions of their votaries." His behaviour so enraged the governor, that he ordered him immediately to be beheaded. In his way to execution, he was stopped by a river, over which was a bridge so thronged with spectators that it was impossible to cross it; the saint, as we are told, lifted up his eyes to heaven, and the stream was miraculously divided, and afforded a passage for himself and a thousand more persons. Bede does not indeed give us the name of this river; but, notwithstanding this omission, the miracle, we suppose, will not be the less believed. This wonderful event converted the executioner upon the spot, who threw away his drawn sword, and, falling at St Alban's feet, desired he might have the honour to die with him. This sudden conversion of the headsman occasioning a delay in the execution till another person could be got to perform the office, St Alban walked up to a neighbouring hill, where he prayed for water to quench his thirst, and a fountain of water sprung up under his feet: here he was beheaded, on the 23d of June. The executioner is said to have been a signal example of divine vengeance; for as soon as he gave the fatal stroke, his eyes dropt out of his head. We may see the opinion of Mr Milton in regard to this narrative, in his History of England. His words are these, speaking of St Alban: "The story of whose martyrdom, soiled and worse martyred with the fabling zeal of some idle fancies, more fond of miracles than apprehensive of the truth, deserves no longer digression." Between 400 and 500 years after St Alban's death, Offa, king of the Mercians, built a very large and stately monastery to his memory; and the town of St Albans in Hertfordshire takes its name from our protomartyr.

ALBANA, in *Ancient Geography*, a sea-port town of Albania, on the Caspian sea, between the rivers Casius and Albanus; now called *Bachu*, or *Bachy*, giving name to the Caspian sea, viz. *Mer de Bahu*. E. Long. 49. 0. N. Lat. 40. 0.

ALBANENSES, in *Church History*, the same with Albigenses. See Albigenses.

ALBANI,

Albani.

ALBANI, in *Roman Antiquity*, a college of the *Salii*, or priefts of Mars; fo called from Mount Albanus, the place of their refidence. See SALII.

ALBANI, *Francis*, a celebrated painter, born in Bologna, March 17. 1578. His father was a filk merchant, and intended to bring up his fon to that bufinefs; but Albani having a ftrong inclination to painting, when his father died, devoted himfelf entirely to that art, though then but twelve years of age. He firft ftudied under Denys Calvert; Guido Rheni being at the fame time under this mafter, with whom Albani contracted a very great friendfhip. Calvert drew but one profile for Albani, and afterwards left him entirely to the care of Guido; under whom he made great improvement, his fellow-difciple inftructing him with the utmoft humanity and good humour. He followed Guido to the fchool of the Caracci: but a little after their friendfhip for each other began to cool; which was owing perhaps to the pride of Albani, who could not bear to fee Guido furpafs him, or to the jealoufy of Guido at finding Albani make fuch rapid progrefs. They certainly endeavoured to eclipfe one another; for when Guido had fet up a beautiful altar-piece, Albani would oppofe to it fome fine picture of his: thus did they behave for fome time, and yet fpoke of each other with the higheft efteem. Albani, after having greatly improved himfelf under the Caracci, went to Rome, where he continued many years, and married in that city; but his wife dying in childbed, at the earneft requeft of his relations he returned to Bologna, where he entered again into the ftate of matrimony. His fecond wife (Doralice) was well defcended, but had very little fortune; which he perfectly difregarded, fo ftrongly was he captivated with her beauty and good fenfe. Albani, befides the fatisfaction of poffeffing an accomplifhed wife, reaped likewife the advantage of having a moft beautiful model; fo that he had now no occafion to make ufe of any other woman to paint a Venus, the Graces, Nymphs, and other deities, whom he took a particular delight in reprefenting. His wife anfwered this purpofe admirably well; for befides her bloom of youth, and the beauty of her perfon, he difcovered in her fo much modefty, fo many graces and perfections, fo well adapted to painting, that it was impoffible for him to meet with a more finifhed woman. She afterwards brought him feveral boys, all extremely beautiful and finely proportioned; fo that fhe and her children were the originals of his moft agreeable and graceful compofitions. Doralice was fo conformable to his intentions, that fhe took a pleafure in fetting the children in different attitudes, holding them naked, and fometimes fufpended by ftrings, when Albani would draw them in a thoufand different ways. It was from them, too, that the famous fculptors Flamand and Argaldi modelled their little Cupids.

Albani was of a happy temper and difpofition; his paintings, fays Malvafia, breathing nothing but content and joy. Happy in a force of mind that conquered every uneafinefs, his poetical pencil carried him through the moft agreeable gardens to Paphos and Cytheria: thofe delightful fcenes brought him over the lofty Parnaffus to the delicious abodes of Apollo and the Mufes: whence what Du Frefnoy fays of the famous Giulio Romano may be juftly applied to Albani:

Taught from a child in the bright Mufes' grots,
He open'd all the treafures of Parnaffus,
And in the lovely poetry of painting
The myft'ries of Apollo has reveal'd.

He died the 4th of October 1660, to the great grief of all his friends and the whole city of Bologna. Malvafia has preferved fome verfes of Francifco de Lemene, intended for his monument; the fenfe whereof is, "That the mortal remains of the illuftrious Albani, he who gave life to fhade, lie interred in this tomb: the earth never produced fo wonderful an artift, or a hand equal to his immortal one; which gave colours to the foul, and a foul to colours. Prometheus animated clay, and gave life by means of the fun; but Albani animated merely by the affiftance of fhade." He was very famous in his lifetime, and had been vifited by the greateft painters. Several princes honoured him with letters; and amongft the reft King Charles I. who invited him to England by a letter figned with his own hand.

Albania.

ALBANIA, a province of Turkey in Europe, on the gulf of Venice, bounded by Livadia on the fouth, by Theffaly and Macedonia on the eaft, and on the north by Bofnia and Dalmatia. The people are ftrong, large, courageous, and good horfemen; but are faid to be of a thievifh difpofition. The grand feignior procures excellent foldiers from hence, particularly cavalry, known by the name of *Arnauts*. There are feveral large towns in this province; and the inhabitants are almoft all Chriftians of the Greek church, and defcended from the ancient Scythians. Formerly it was part of the kingdom of Macedonia. Their chief manufacture is carpets. The principal places are Durazzo, Velona, Antivari, Scutari, Croya, Aleffo, Dibra, Dolcigno, and Albanapoli. Long. from 18° to 21° E. Lat. from 39° to 43° N.

ALBANIA, a country of Afia, bounded on the weft by Iberia; on the eaft by the Cafpian fea; on the north by Mount Caucafus; on the fouth by Armenia, and the river Cyrus, now Kur; which, fpringing from the Mofchian mountains that feparate Colchis from Armenia, and watering the country of Mokan, receives the Aragus and Araxes, and falls into the Cafpian fea within a fmall diftance from the fouthern borders of this country.—The whole country formerly called *Albania*, now goes under the names of *Schirwan* and *Eaft-Georgia*, and is extremely fruitful and pleafant. The ancient hiftorians take notice of the Albanian men being tall, ftrong-bodied, and, generally fpeaking, of a very graceful appearance; far excelling all other nations in comelinefs as well as ftature. Modern travellers take no notice of the appearance of the men; but extol the beauty of the women, which feems to be unnoticed by the ancients. The Albanians were anciently an independent and pretty powerful people; but we find no mention made of their kings till the reign of Alexander the Great, to whom the king of Albania is faid to have prefented a dog of an extraordinary fiercenefs and fize.—It does not appear that the Albanians were ever conquered by the Romans, even when their power was at the greateft height; though when they ventured to engage in war with that powerful empire, they were always defeated, as might naturally be expected.

ALBANO, a town of Italy, on a lake of the fame name

name, in the Campagna of Rome. It was called by the ancients *Albanum Pompeii*, and built out of the ruins of the ancient Alba Longa, which was deftroyed by Tullus Hoftilius. It ftands within twelve miles fouth-eaft of Rome, and for the pleafantnefs of its fituation is the fummer retirement of a great many Roman princes. It is likewife the fee of a bifhop, who is one of the fix fenior cardinals. The town is famous for its excellent wine, and the ruins of a maufoleum, which, according to the tradition of the inhabitants, was made for Afcanius. The profpect from the garden of the Capuchins is extremely pleafant, taking in the Campania of Rome, and terminating in a full view of the Tufcan fea. Clofe by the town lies the Alban lake, of an oval figure, and about feven miles in circumference, which, by reafon of the high mountains round it, looks like the area of a great amphitheatre. It abounds with excellent fifh, and over againft the hermitage it is faid to be unfathomable. The mountain of Albano is called *Monte Cavo;* on the top of which was a celebrated temple dedicated to Jupiter and Juno. Near the Capuchins there is another convent of Francifcans; and not far from thence the palace of Cardinal Barberini, remarkable for very pleafant gardens, with the ruins of ancient baths, and feveral old fragments of mofaic work. E. Long. 13. 10. N. Lat. 41. 43.

Albano is alfo a town in the kingdom of Naples, remarkable for the fertility of the furrounding territory, and for the nobility of the inhabitants.

ALBANS, Saint, a market town of Hertfordfhire, is a very great thoroughfare, accommodated with good inns, on the north-weft road from London, at the diftance of 21 miles. This town fends two members to parliament, gives the title of *duke* to the noble family of Beauclerc, and has one of the beft markets for wheat in England. St Albans is feated near the ruins of an ancient Roman city, by Tacitus called *Verulam;* and by the Saxons *Watlingcefter*, becaufe it is feated on the road called *Watlingftreet*. Nothing now remains of Verulam but the ruins of old walls; in the fields adjacent to which they continue to find Roman coins, as they formerly found teffelated pavements. In memory of St Alban, Offa, king of the Mercians, *anno* 795, erected an abbey, calling it *St Albans;* and near it the town of the fame name was afterwards built. The church of the abbey is remaining to this day: time and the weather have made it look like ftone on the outfide; but if you break a bit off, the rednefs of the brick immediately appears. When the monafteries were diffolved, the townfmen paid 400l. to prevent its being levelled with the ground, and have fince converted it into a parifh-church, which, for its largenefs, beauty, and antiquity, claims a particular regard. It had a very noble font of folid brafs, in which the children of the kings of Scotland were ufed to be baptized; and was brought from Edinburgh, by Sir Philip Lea, when the city was in flames; but in the times of the late civil wars, it was taken away. Not many years fince, a tomb was difcovered in this church, faid to be that of Humphry duke of Gloucefter: when the leaden coffin was opened, the body was pretty entire, being preferved in a fort of pickle. There was a ftately crofs in the middle of the town, as there were in many other places, where Queen Eleanor's body refted when it was brought out of the north for interment at Weftminfter; but it is now demolifhed. W. Long. 0. 12. N. Lat. 51. 44.

ALBANUS mons, in *Ancient Geography*, now called *Mont Albano*, 26 miles from Rome, near where Alba Longa ftood.

Albanus mons, in *Ancient Geography*, to the north of Iftria, called *Albius* by Strabo; the extremity of the Alps, which, together with the mountains to the eaft, joining it, called *Montes Bæbii*, feparate the farther Liburnia and Dalmatia from Pannonia.

ALBANY, a fortrefs belonging to the Britifh, feated on the S. W. of Hudfon's bay. W. Long. 84. 20. N. Lat. 53. 20.

Albany, a town of North America, the capital of one of the ten counties of the province of New-York, which goes by the fame name, is a well-built place, confidering the country. Here the fachems, or the kings of the Five Nations of Iroquois, met the governors of the Britifh plantations, when they entered into any treaty with them. W. Long. 44. 29. N. Lat. 42. 30.

ALBARAZIN, a ftrong town, and one of the moft ancient of the kingdom of Arragon in Spain. It is feated upon an eminence, near the river Guadalquivir, a little below its fource, and on the frontiers of Valencia and New Caftile. It is the feat of a bifhop, and produces the beft wool in all Arragon. It is about 100 miles eaft of Madrid. E. Long. 2. 10. N. Lat. 40. 32.

ALBARII, in *Antiquity*, properly denoted thofe who gave the whitening to earthen veffels, &c. In which fenfe they ftood contradiftinguifhed from *Dealbatores*, who whitened walls.

ALBARIUM opus, in the ancient building, the incruftation or covering of the roofs of houfes with white plafter, made of mere lime. This is otherwife called *opus album*. It differs from *Tectorium*, which is a common name given to all roofing or ceiling, including even that formed of lime and fand, or lime and marble; whereas *Albarium* was reftrained to that made of lime alone.

ALBATEGNI, an Arabic prince of Batan in Mefopotamia, and a celebrated aftronomer, who lived about the year of Chrift 880, as appears by his obfervations. He is alfo called *Muhammed ben Geber Albatani*, *Mahomet the fon of Geber*, and *Muhamedes Aractenfis*. He made aftronomical obfervations at Antioch, and at Racah or Aracta, a town of Chaldea. He is highly fpoken of by Dr Halley as a man of admirable genius, and an excellent obferver.

Inftead of the tables of Ptolemy which were imperfect, he computed new ones: thefe were adapted to the meridian of Aracta or Racah, and were long ufed as the beft among the Arabs. Albategni compofed in Arabic a work under the title of *The Science of the Stars*, comprifing all parts of aftronomy, according to his own obfervations and thofe of Ptolemy. This work was tranflated into Latin by Plato of Tibur, and publifhed at Nuremberg in 1537, with fome additions and demonftrations of Regiomontanus. It was reprinted at Bologna in 1645, with this author's notes. Dr Halley detected many faults in thefe editions: *Philof. Tranf.* for 1693, N° 204. In this work, Albategni gives the motion of the fun's apogee fince Ptolemy's time, as well as the motion of the ftars, which he

makes

makes one degree in 70 years. He made the longitude of the firſt ſtar of Aries to be 18° 2′; and the obliquity of the ecliptic 23° 35′. Upon Albategni's obſervations were founded the Alphonſine tables of the moon's motions. (*Hutton's Math. Dict.*)

ALBATI EQUI, an appellation given to ſuch horſes, in the games of the ancient circus, as wore white furniture.

ALBATROSS, in *Ornithology*, a ſpecies of the diomedea. See DIOMEDEA, ORNITHOLOGY *Index*.

ALBAZIN, a town of Greater Tartary, with a ſtrong caſtle. It is ſituated upon the river Amur, or Yamour, and belongs to the Muſcovites. E. Long. 103. 30. N. Lat. 54. 0.

ALBE, a ſmall piece of money, current in Germany, worth only a French ſol and ſeven deniers.

ALBEMARLE, or AUMARLE, a town of France, in Upper Normandy, and in the territory of Caux, from whence the noble family of Keppel takes the title of *Earl*. The ſerges of this town are in high eſteem. It is ſeated on the declivity of a hill, on the confines of Picardy, 35 miles north-eaſt of Rouen, and 70 north-weſt of Paris. E. Long. 2. 21. N. Lat. 49. 50.

ALBEMARLE, the moſt northern part of the province of North Carolina in America.

ALBENGUA, a town of Italy, in the territory of Genoa. It is the ſee of a biſhop; and is a very ancient handſome town, but not well peopled, on account of the inſalubrity of the air. It is ſeated in a very beautiful plain, which is well cultivated; and the outſide of the town is ſurrounded with olive-trees. It is a ſea-port, about 38 miles ſouth-weſt of Genoa. E. Long. 8. 13. N. Lat. 44. 4.

ALBERNUO, a kind of camlet, brought from the Levant by the way of Marſeilles.

ALBERONI, JULIUS, the ſon of a poor gardener in the ſuburbs of Placentia, born in 1664; who, by his great abilities and good fortune, roſe from this low origin to the employment of firſt miniſter of ſtate at the court of Spain, and to the dignity of cardinal. He rouſed that kingdom out of the lethargy it had ſunk into for a century paſt; awakened the attention, and raiſed the aſtoniſhment of all Europe, by his projects; one of which was to ſet the Pretender on the throne of Great Britain. He was at length deprived of his employment, and baniſhed to Rome. He died in 1752, at the great age of 89. His *Teſtament Politique*, collected from his memoirs and letters, was publiſhed at Lauſanne in 1753.

ALBERT, Margrave of Brandenburg, and the laſt grand maſter of the Teutonic order, laid aſide the habit of his order, embraced Lutheraniſm, and concluded a peace at Cracow in 1525, by which he was acknowledged duke of the eaſt part of Pruſſia (formerly called for that reaſon *Ducal Pruſſia*), but to be held as a fief of Poland, and to deſcend to his male heirs. See PRUSSIA.

ALBERTI, LEONE BATTISTA, was deſcended from a noble family in Florence; and was perfectly acquainted with painting, ſculpture, and architecture. He wrote of all three in Latin; but his ſtudies did not permit him to leave any thing conſiderable behind him in painting. He was employed by Pope Nicholas V. in his buildings, which he executed in a beautiful manner; and his work on architecture, which conſiſts of 10 books, is greatly eſteemed. He alſo wrote ſome treatiſes of morality, and a piece of arithmetic. He died in 1485.

ALBERTISTS, a ſect of ſcholaſtics, ſo named from their leader Albertus Magnus.

ALBERTUS, MAGNUS, a Dominican friar, and afterwards biſhop of Ratiſbon, was one of the moſt learned men and moſt famous doctors of the 13th century. He is ſaid to have acted as a man-midwife; and ſome have been highly offended that one of his profeſſion ſhould follow ſuch an employment. A book entitled *De Natura Rerum*, of which he was reputed the author, gave riſe to this report. In this treatiſe there are ſeveral inſtructions for midwives, and ſo much ſkill ſhown in their art, that one would think the author could not have arrived at it without having himſelf practiſed: but the advocates for Albert ſay he was not the writer thereof, nor of that other piece *De Secretis Mulierum*; in which there are many phraſes and expreſſions unavoidable on ſuch a ſubject, which gave great offence, and raiſed a clamour againſt the ſuppoſed author. It muſt be acknowledged, however, that there are, in his Comment upon the Maſter of Sentences, ſome queſtions concerning the practice of conjugal duty, in which he has uſed ſome words rather too groſs for chaſte and delicate ears; but they allege what he himſelf uſed to ſay in his own vindication, that he came to the knowledge of ſo many monſtrous things at confeſſion, that it was impoſſible to avoid touching upon ſuch queſtions. Albert was certainly a man of a moſt curious and inquiſitive turn of mind, which gave riſe to other accuſations brought againſt him. It is ſaid, that he laboured to find out the philoſopher's ſtone; that he was a magician; and that he made a machine in the ſhape of a man, which was an oracle to him, and explained all the difficulties he propoſed. He had great knowledge in the mathematics, and by his ſkill in that ſcience might probably have formed a head with ſprings capable of articulating ſounds; like to the machines of Boetius, of which Caſſiodorus has ſaid, "Metals lowe; the birds of Diomedes trumpet in braſs; the brazen ſerpent hiſſes; counterfeited ſwallows chatter, and ſuch as have no proper note, from braſs ſend forth harmonious muſic." John Matthæus de Luna, in his treatiſe *De Rerum Inventoribus*, has attributed the invention of fire-arms to Albert; but in this he is confuted by Naude, in his *Apologie des Grandes Hommes*. Albert died at Cologne in 1280. His works were printed at Lyons, in 1651, in 21 volumes in folio.

ALBERTUS, a gold coin, worth about fourteen French livres: it was coined during the adminiſtration of Albertus archduke of Auſtria.

ALBESIA, in *Antiquity*, a kind of ſhields otherwiſe called *Decumana*. See DECUMANA.

ALBI, a city of France, in the department of the Tarn, the capital of the Albigeois, in Upper Languedoc. The cathedral is dedicated to St Cecilia, and has one of the fineſt choirs in the kingdom. Here is a very valuable ſilver ſhrine, of exquiſite workmanſhip, of the moſaic kind: it contains the reliques of St Clair, the firſt biſhop of this city. The chapel of this pretended ſaint is magnificent, and adorned with paintings. The Lice is a fine large walk without the city: what diſtinguiſhes this from all others, is a terrace

Albigenses. above a deep mall, which serves instead of a fosse; it is bordered with two rows of very fine trees, which are kept in excellent order. There are four gates, through which you may view all the beauties of a delightful plain. At one end of this is the convent of the Dominicans. The archbishop's palace is very beautiful. The river washes its walls, and serves both for an ornament and defence. This city is seated on the river Tarn, 35 miles north-east of Toulouse, and 250 south of Paris. E. Long. 2. 9. N. Lat. 43. 56.

The Albigeois is a small territory about twenty-seven miles in length, and twenty in breadth, abounding in corn, woad, grapes, saffron, plums, and sheep; and the inhabitants have a great trade in dried prunes, grapes, a coarse sort of cloth, and wines of Gaillac. These wines are the only sort hereabouts that are fit for exportation: they are carried down to Bourdeaux, and generally sold to the British. They have likewise several coal mines.

ALBIGENSES, in *Church History*, a sect or party of reformers, about Toulouse and the Albigeois in Languedoc, who sprung up in the 12th century, and distinguished themselves by their opposition to the discipline and ceremonies of the Romish church.

This sect had their name, it is supposed, either by reason there were great numbers of them in the diocese of Albi, or because they were condemned by a council held in that city. In effect, it does not appear that they were known by this name before the holding of that council. The *Albigenses* were also called *Albiani*, *Albigesei*, *Albii*, and *Albanenses*, though some distinguish these last from them. Other names given to them are, *Henricians*, *Abelardists*, *Bulgarians*, &c.; some on account of the qualities they assumed; others on that of the country from whence it is pretended they were derived; and others on account of persons of note who adopted their cause, as Peter de Brius, Arnold de Bresse, Abelard, Henry, &c. Berengarius, if not Wickliff himself, is by some ranked in the number. The *Albigenses* are frequently confounded with the *Waldenses*; from whom, however, they differ in many respects, both as being prior to them in point of time, as having their origin in a different country, and as being charged with divers heresies, particularly Manicheism, from whence the *Waldenses* are exempt. But several Protestant writers have vindicated them from that imputation. Dr Allix shows that a great number of *Manichees* did spread over the western countries from Bulgaria; and settled in Italy, Languedoc, and other places, where they were also *Albigenses*; by which means, being both under the imputation of *heresy*, they came, either by ignorance or malice, to be confounded, and called by the same common name, though in reality entirely different.

Other errors imputed to them by their opponents, the monks of those days, were, That they admitted two Christs; one evil, who appeared on earth; the other good, who has not yet appeared: That they denied the resurrection of the body; and maintained human souls to be demons imprisoned in our bodies, by way of punishment for their sins: That they condemned all the sacraments of the church; rejected baptism as useless; held the eucharist in abhorrence; excluded the use of confessions and penance; maintained marriage unlawful; laughed at purgatory, prayers for the dead, images, crucifixes, &c. There were likewise said to be two classes of them; the Perfect, and the Believers. The perfect boasted of their living in continence, of eating neither flesh, eggs, nor cheese. The believers lived like other men, and were even loose in their morals; but they were persuaded they should be saved by the faith of the perfect, and that none were damned who received imposition of hands from them. But from these charges also they are generally acquitted by Protestants; who consider them as the pious inventions of the Romish church, whose members deem it meritorious by any means to blacken heretics.

However this be, the Albigenses grew so formidable, that the Catholics agreed upon a holy league or crusade against them. They were at first supported by Raimond, count of Toulouse. Pope Innocent III. desirous to put a stop to their progress, sent a legate into their country; which failing, he stirred up Philip Augustus, king of France, and the other princes and great men of the kingdom, to make war upon them. Upon this the count of Toulouse, who had sided with them, made his submission to the pope, and went over to the Catholics: but soon after, finding himself plundered by the crusades, he declared war against them, and was joined by the king of Arragon. His army was defeated at the siege of Muret, where he himself was killed, and the defeat followed by the surrender of the city of Toulouse, and the conquest of the greatest part of Languedoc and Provence. His son Raymond succeeded him; who agreed with the king and the pope to set up the inquisition in his estates, and to extirpate the Albigenses. In an assembly held at Milan, the archbishop of Toulouse drew up articles; agreeable to which the count made a most ample declaration against them, which he published at Toulouse in 1253. From this time the Albigenses dwindled by little and little, till the time of the Reformation; when such of them as were left fell in with the Vaudois, and became conformable to the doctrine of Zuinglius and the discipline of Geneva.

Albigenses is also a name sometimes given to the followers of Peter Vaud, or Waldo; and hence synonymous with what we more properly call *Waldenses*, or Poor Men of Lyons. In this sense the word is applied by Camerarius, Thuanus, and several other writers. The reason seems to be, that the two parties agreed in their opposition to the papal innovations and encroachments, though in divers other respects said to be different enough. The bishop of Meaux labours hard to support a distinction between the two sects, alleging that the *Albigenses* were heretics and Manichees; whereas the *Waldenses* were only schismatics, not heretics; being sound as to articles of faith, and only separating from the church of Rome on account of forms and discipline. Dr Allix endeavours to set aside the distinction: and shows, that both of them hold the same opinions, and were equally condemned and held for heretics; and this not for points of faith, but for declaiming against the papal tyranny and idolatry, and holding the pope to be the Antichrist; which last, according to M. de Meaux, constitutes nothing less than Manicheism. In this sense the Lollards and Wickliffites in England were not only Albigenses but Manichees.

Albintemelium ‖ Albinos.

ALBINTEMELIUM. Albintimilium, (Tacitus); or at full length, Albium Intemelium, (Pliny, Strabo); now *Vintimiglia*, ſituated in the ſouth-weſt of the territory of Genoa, near the borders of the county of Nice, with a port on the Mediterranean, at the mouth of the rivulet Rotta, about halfway between Monaco and S. Remo. E. Long. 7. 40. N. Lat. 43. 17.

ALBIOECE, or Alebece, (Pliny, Strabo); otherwiſe called *Reii Apollinares*, from their ſuperſtitious worſhip of Apollo; alſo *Civitas Reienſium;* now *Riez*, in Provence, about 18 leagues to the north-eaſt of Toulon, on the north ſide of the rivulet Verdon; was originally a Roman colony, (Inſcription). It is ſometimes written *Regium*. The people were called *Albici*, (Cæſar.) E. Long. 1. 0. N. Lat. 43. 20.

ALBINI, in *Antiquity*, the workmen employed in what was called *Opus Albarium*. They make a different profeſſion from the *dealbatores* or *whiteners*.

ALBINOS, the name by which the Portugueſe call the white Moors, who are looked upon by the negroes as monſters. They at a diſtance might be taken for Europeans; but, when you come near them, their white colour appears like that of perſons affected with a leproſy.

In Sauſſure's *Voyages dans les Alpes*, is the following account of two boys, at Chamouni, who have been called *Albinos*. "The elder, who was at the end of the year 1785 about twenty, or one-and-twenty years of age, had a dull look, with lips ſomewhat thick, but nothing elſe in his features to diſtinguiſh him from other people. The other, who is two years younger, is rather a more agreeable figure; he is gay and ſprightly, and ſeems not to want wit. But their eyes are not blue; the iris is of a very diſtinct roſe colour; the pupil too, when viewed in the light, ſeems decidedly red; which ſeems to demonſtrate, that the interior membranes are deprived of the uvea, and of that black mucous matter that ſhould line them. Their hair, their eye-brows, and eye-laſhes, the down upon their ſkin, were all, in their infancy, of the moſt perfect milk-white colour, and very fine; but their hair is now of a reddiſh caſt, and has grown pretty ſtrong. Their ſight too is ſomewhat ſtrengthened; though they exaggerate to ſtrangers their averſion for the light, and half ſhut the eye-lids, to give themſelves a more extraordinary appearance. But thoſe who, like me, have ſeen them in their infancy, before they were tutored to this deceit, and when too few people came to Chamouni to make this affectation profitable to them, can atteſt that then they were not very much offended with the light of day. At that time they were ſo little deſirous of exciting the curioſity of ſtrangers, that they hid themſelves to avoid ſuch; and it was neceſſary to do a ſort of violence to them before they could be prevailed on to allow themſelves to be inſpected. It is alſo well known at Chamouni, that when they were of a proper age they were unable to tend the cattle like the other children at the ſame age; and that one of their uncles maintained them out of charity, at a time of life when others were capable of gaining a ſubſiſtence by their labour.

"I am therefore of opinion, that we may conſider theſe two lads as true albinos; for if they have not the thick lips and flat noſes of the white negroes, it is becauſe they are albinos of Europe, not of Africa. This infirmity affects the eyes, the complexion, and the colour of the hair; it even diminiſhes the ſtrength, but does not alter the conformation of the features. Beſides, there are certainly in this malady various degrees; ſome may have leſs ſtrength, and be leſs able to endure the light: but theſe circumſtances in thoſe of Chamouni are marked with characters ſufficiently ſtrong to entitle them to the unhappy advantage of being claſſed with that variety of the human ſpecies denominated albinos.

"When nature preſents the ſame appearance often, and with circumſtances varied, we may at laſt diſcover ſome general law, or ſome relation which that appearance has with known cauſes: but when a fact is ſo ſingular and ſo rare, as that of thoſe albinos, it gives but little ſcope to conjecture: and it is very difficult to verify thoſe by which we attempt to explain it.

"I at firſt imagined that this diſeaſe might be referred to a particular ſort of organic debility; that a relaxation of the lymphatic veſſels within the eye might ſuffer the globules of the blood to enter too abundantly into the iris, the uvea, and even into the retina, which might occaſion the redneſs of the iris and of the pupil. The ſame debility ſeemed alſo to account for the intolerance of the light, and for the whiteneſs of the hair.

"But a learned phyſiologiſt, M. Blumenbach, profeſſor in the univerſity at Gottingen, who has made many profound obſervations on the organs of ſight, and has conſidered with great attention the albinos of Chamouni, attributes their infirmity to a different cauſe.

"The ſtudy of comparative anatomy has furniſhed him with frequent opportunities of obſerving this phenomenon; he has found it in brutes, in white dogs, and in owls; he ſays, it is generally to be ſeen in the warm-blooded animals; but that he has never met with it in thoſe with cold blood.

"From his obſervations, he is of opinion, that the redneſs of the iris, and of the other internal parts of the eye, as well as the extreme ſenſibility that accompanies this redneſs, is owing to the total privation of that brown or blackiſh mucus, which, about the fifth week after conception, covers all the interior parts of the eye in its ſound ſtate. He obſerves, that Simon Pontius, in his treatiſe *de Coloribus Oculorum*, long ago remarked, that in blue eyes the interior membranes were leſs abundantly provided with this black mucus, and were therefore more ſenſible to the action of light. This ſenſibility of blue eyes agrees very well, ſays M. Blumenbach, with northern people, during their long twilight; while, on the contrary, the deep black in the eyes of negroes enables them to ſupport the ſplendour of the ſunbeams in the torrid zone.

"As to the connexion between this red colour of the eyes and the whiteneſs of the ſkin and hair, the ſame learned phyſiologiſt ſays, that it is owing to a ſimilarity of ſtructure, *conſenſus ex ſimilitudine fabricæ*. He aſſerts, that this black mucus is formed only in the delicate cellular ſubſtance, which has numerous blood-veſſels contiguous to it, but contains no fat; like the inſide of the eye, the ſkin of negroes, the ſpotted palate of ſeveral domeſtic animals, &c. And, laſtly, he ſays, Albinos. ſays, that the colour of the hair generally correſponds with that of the iris. *Gazette litt. de Gotingue*, Oct. 1784.

"At the very time that M. Blumenbach was reading this memoir to the Royal Society of Gottingen, M. Buzzi, ſurgeon to the hoſpital at Milan, an eleve of the celebrated anatomiſt Moſcati, publiſhed in the *Opuſcoli Scelti de Milan*, 1784, tom. vii. p. 11. a very intereſting memoir, in which he demonſtrates by diſſection what Blumenbach had only ſuppoſed.

"A peaſant of about 30 years of age died in the hoſpital of Milan of a pulmonary diſorder. His body, being expoſed to view, was exceedingly remarkable by the uncommon whiteneſs of the ſkin, of the hair, of the beard, and of all the other covered parts of the body. M. Buzzi, who had long deſired an opportunity of diſſecting ſuch a ſubject, immediately ſeized upon this. He found the iris of the eyes perfectly white, and the pupil of a roſe colour. The eyes were diſſected with the greateſt poſſible care, and were found entirely deſtitute of that black membrane which anatomiſts call the *uvea*: it was not to be ſeen either behind the iris or under the retina. Within the eye there was only found the choroid coat extremely thin, and tinged of a pale red colour, by veſſels filled with diſcoloured blood. What was more extraordinary, the ſkin, when detached from different parts of the body, ſeemed almoſt entirely diveſted of the *rete mucoſum*: maceration did not diſcover the leaſt veſtige of this, not even in the wrinkles of the abdomen, where it is moſt abundant and moſt viſible.

"M. Buzzi likewiſe accounts for the whiteneſs of the ſkin and of the hair, from the abſence of the *rete mucoſum*, which, according to him, gives the colour to the cuticle, and to the hairs that are ſcattered over it. Among other proofs of this opinion, he alleges a well-known fact, that if the ſkin of the blackeſt horſe be accidentally deſtroyed in any part of the body, the hairs that afterwards grow on that part are always white, becauſe the *rete mucoſum* which tinges thoſe hairs is never regenerated with the ſkin.

"The proximate cauſe of the whiteneſs of albinos, and the colour of their eyes, ſeems therefore pretty evidently to depend on the abſence of the *rete mucoſum*: But what is the remote cauſe?

"In the firſt place, it ſeems probable that men affected with this infirmity form no diſtinct ſpecies, for they are produced from parents that have dark ſkins and black eyes. What is it then that deſtroys the *rete mucoſum* in ſuch perſons? M. Buzzi relates a ſingular fact, which ſeems to throw ſome light on this ſubject.

"A woman of Milan, named Calcagni, had ſeven ſons. The two eldeſt had brown hair, and black eyes; the three next had white ſkins, white hair, and red eyes; the two laſt reſembled the two eldeſt. It was ſaid that this woman, during the three pregnancies that produced the albinos, had a continual and immoderate appetite for milk, which ſhe took in great quantities: but that when ſhe was with child of the other four children, ſhe had no ſuch deſire. It is not however aſcertained, that this preternatural appetite was not itſelf the effect of a certain heat, or internal diſeaſe, which deſtroyed the *rete mucoſum* in the children before they were born.

"The albinos of Chamouni are alſo the offſpring of parents with dark ſkins and black eyes. They have three ſiſters by the ſame father and mother, who are alſo brunettes. One of them that I ſaw had the eyes of a dark brown, and the hair almoſt black. They are ſaid, however, to be all afflicted with a weakneſs of ſight. When the lads are married, it will be curious to obſerve how the eyes of their children will be formed. The experiment would be particularly deciſive if they were married to women like themſelves. But this faulty conformation ſeems to be more rare among women than among men; for the four of Milan, the two of Chamouni, the one deſcribed by Maupertuis, the one by Helvetius, and almoſt all the inſtances of theſe ſingular productions, have been of our ſex. It is known, however, that there are races of men and women affected with this diſeaſe, and that theſe races perpetuate themſelves in Guinea, in Java, at Panama, &c.

"Upon the whole, this degeneration does not ſeem to be owing to the air of the mountains; for though I have traverſed the greateſt part of the Alps, and the other mountains of Europe, theſe are the only individuals of the kind that ever I met with."

Albinovanus, Albinus. ALBINOVANUS, a Latin poet, whom Ovid ſurnamed the *Divine*. There is now nothing of his extant, except an Elegy on Druſus, and another on the Death of Mecænas.

ALBINUS, Bernhard Siegfred, a celebrated phyſician and anatomiſt, was born of an illuſtrious family at Francfort on the Oder in 1697. His father was then profeſſor of the practice of medicine in the univerſity of Francfort; but in the year 1702 he repaired to Leyden, being nominated profeſſor of anatomy and ſurgery in that univerſity. Here his ſon had an opportunity of ſtudying under the moſt eminent maſters in Europe, who, from the ſingular abilities which he then diſplayed, had no difficulty in prognoſticating his future eminence. But while he was diſtinguiſhed in every branch of literature, his attention was particularly turned to anatomy and ſurgery. His peculiar attachment to theſe branches of knowledge gained him the intimate friendſhip of Ruyſch and Rau, who at that time flouriſhed in Leyden; and the latter, ſo juſtly celebrated as a lithotomiſt, is ſaid to have ſeldom performed a capital operation without inviting him to be preſent. Having finiſhed his ſtudies at Leyden, he went to Paris, where he attended the lectures of Du Verney, Vaillant, and other celebrated profeſſors. But he had ſcarce ſpent a year there, when he was invited by the curators of the univerſity of Leyden, to be a lecturer in anatomy and ſurgery at that place. Though contrary to his own inclination, he complied with their requeſt, and upon that occaſion was created doctor of phyſic without any examination. Soon after, upon the death of his father, he was appointed to ſucceed him as profeſſor of anatomy; and upon being admitted into that office on the 9th of November 1721, he delivered an oration, *De vera via ad fabricæ humani corporis cognitionem ducente*; which was heard with univerſal approbation. In the capacity of a profeſſor, he not only beſtowed the greateſt attention upon the inſtruction of the youth entruſted to his care, but in the improvement of the medical art. With this view, he publiſhed many important diſcoveries of his own; and by by elegant editions, turned the attention of phyſicians to works of merit, which might otherwiſe have been neglected. By theſe means his fame was ſoon extended over Europe; and the ſocieties of London, Peterſburgh, and Haerlem, cheerfully received him as an aſſociate. In 1745, he was appointed profeſſor of the practice of medicine at Leyden, and was ſucceed in the anatomical chair by his brother Frid. Bern. Albinus. He was twice rector of the univerſity, and as often he refuſed that high honour when it was voluntarily offered him. At length, worn out by long ſervice and intenſe ſtudy, he died on the 9th of September 1770, in the 74th year of his age.

ALBION, the ancient name of Britain.

New Albion, a name given by Sir Francis Drake to California, on the north-weſt coaſt of America, which he diſcovered and took poſſeſſion of in the year 1578. Captain Cook viſited this coaſt in 1778, and landed in a place ſituated in N. Lat. 44. 33. E. Long. 235. 20. In the year 1792, it was again viſited by Captain Vancouver, who was employed in ſurveying the weſtern coaſt of North America. The extent of New Albion, according to the latter circumnavigator is between the 30th and 45th degrees of N. Latitude.

ALBIREO, in *Aſtronomy*, a ſtar of the third or fourth magnitude, in the conſtellation Cygnus.

ALBIS, in *Ancient Geography*, now the Elbe, which divided ancient Germany in the middle, and was the boundary of this country, ſo far as it was known to the Romans: all beyond they owned to be uncertain, no Roman except Druſus and Tiberius having penetrated ſo far as the Elbe. In the year of the building of the city 744, or about ſix years before Chriſt, Domitius Ahenobarbus, croſſing the river with a few, merited the ornaments of a triumph; ſo glorious was it reckoned at Rome to have attempted the paſſage. In the following age, however, the river that before occupied the middle of ancient Germany, became its boundary to the north, from the irruptions of the Sarmatæ, who poſſeſſed themſelves of the Tranſalbin Germany. The Elbe riſes in the borders of Cilicia out of the Riſenberg, runs through Bohemia, Miſnia, Upper Saxony, Anhalt, Magdeburg, Brandenburg, Danneberg, Lauenburg, Holſtein, and after being ſwelled by many other rivers, and paſſing by Hamburg and Gluckſtadt, to both which places the river is navigable by large veſſels, falls into the German or North ſea.

ALBISOLA, a ſmall town belonging to the republic of Genoa. Here is a porcelain manufacture, and ſeveral country-houſes of the Genoeſe nobility. It was bombarded in 1745 by the Engliſh. E. Long. 8. 20. N. Lat. 44. 15.

ALBOGALERUS, in *Roman Antiquity*, a white cap worn by the *flamen Dialis*, on the top of which was an ornament of olive branches.

ALBORAK, amongſt the *Mahometan Writers*, the beaſt on which Mahomet rode in his journeys to heaven. The Arab commentators give many fables concerning this extraordinary mode of conveyance. It is repreſented as of an intermediate ſhape and ſize between an aſs and a mule. A place, it ſeems, was ſecured for it in paradiſe at the interceſſion of Mahomet; which, however, was in ſome meaſure extorted from the prophet, by Alborak's refuſing to let him mount when the angel Gabriel was come to conduct him to heaven.

ALBORO, in *Zoology*, a name by which the erythrinus, a ſmall red fiſh caught in the Mediterranean, is commonly known in the markets of Rome and Venice.

ALBOURG, a town of Denmark, in North Jutland, capital of the dioceſe of the ſame name, and a biſhop's ſee. It has this name, which ſignifies *eel-town*, on account of the great number of eels taken here. It is ſeated on a canal, 10 miles from the ſea, 30 north of Wiburg, and 50 north of Arhuys. It has an exchange for merchants, and a ſafe and deep harbour. They have a conſiderable trade in herrings and corn; and a manufactory of guns, piſtols, ſaddles, and gloves. E. Long. 29. 16. N. Lat. 56. 35.

ALBRICIUS, born at London, was a great philoſopher, a learned and able phyſician, and well verſed in all the branches of polite literature. He lived in the 11th century, and wrote ſeveral works in Latin; particularly, 1. Of the Origin of the Gods. 2. The Virtues of the Ancients. 3. The Nature of Poiſon, &c.

ALBUCA, Bastard Star-of-Bethlehem. See Botany *Index*.

ALBUGINEA tunica, in *Anatomy*, the third or innermoſt coat or covering of the teſtes; it is likewiſe the name given to one of the coats of the eye.

ALBUGINEUS, in *Anatomy*, a term ſometimes applied to the aqueous humour of the eye.

ALBUGO, or Leucoma, in *Medicine*, a diſtemper occaſioned by a white opaque ſpot growing on the *cornea* of the eye, and obſtructing viſion. See Medicine *Index*.

ALBUM, in *Antiquity*, a kind of white table, or regiſter, wherein the names of certain magiſtrates, public tranſactions, &c. were entered. Of theſe there were various ſorts; as the *album decurionum*, *album ſenatorum*, *album judicum*, *album prætoris*, &c.

Album Decurionum, was the regiſter wherein the names of the decuriones were entered. This is otherwiſe called *matriculatio decurionum*.

Album Senatorum, the liſt of ſenators names, which was firſt introduced by Auguſtus, and renewed yearly.

Album Judicum, that wherein the names of the perſons of thoſe *decuriæ* who judged at certain times were entered.

Album Prætoris, that wherein the *formulæ* of all actions, and the names of ſuch judges as the prætor had choſen to decide cauſes, were written.

The high prieſt entered the chief tranſactions of each year into an *album*, or table, which was hung up in his houſe for the public uſe.

Album is alſo uſed, in later times, to denote a kind of table, or pocket-book, wherein the men of letters with whom a perſon has converſed, inſcribed their names with ſome ſentence or motto.

Album Græcum, the white dung of dogs, formerly preſcribed for inflammations of the throat, &c. but now diſuſed, and chiefly employed by leather-dreſſers to ſoften leather after the application of lime.

ALBUMAZAR, a learned Arabian aſtronomer in the tenth century, who wrote a treatiſe Of the Revolution of the Years.

ALBUMEN, a ſubſtance found both in animal and vegetable

vegetable matters, and in great abundance in the white of eggs. See Chemistry *Index*.

ALBUQUERQUE, a town of Spain, in the province of Eſtremadura, is ſeated on an eminence, nine miles from the frontiers of Portugal. It is commanded by an almoſt impregnable fortreſs, built on a high mountain, and ſerving to defend the town. It carries on a great trade in wool and woollen manufactures. It was taken by the allies of Charles king of Spain in 1705. W. Long. 7. 0. N. Lat. 38. 52.

ALBURN, the Engliſh name of a compound colour, being a mixture of white and red, or reddiſh brown. Skinner derives the word, in this ſenſe, from the Latin *albus*, and the Italian *burno*, from *bruno*, "brown."

ALBURNUM, the ſoft white ſubſtance which in trees is found between the liber or inner bark and the wood, and in progreſs of time acquiring ſolidity, becomes itſelf the wood. From its colour and comparative ſoftneſs, it has been ſtyled by ſome writers the fat of trees, *adeps arborum*.

The alburnum is found in largeſt quantities in trees that are vigorous; though in ſuch as languiſh, or are ſickly, there is a great number of beds. In an oak ſix inches in diameter, this ſubſtance is nearly equal in bulk to the wood. In a trunk of one foot diameter, it is as one to three and a half; of two and a half feet diameter, as one to four and a half, &c. but theſe proportions vary according to the health and conſtitution of the trees.—The alburnum is frequently gnawed in pieces by inſects, which lodge in the ſubſtance, and are nouriſhed from it.

ALBURNUS, in *Zoology*, a ſpecies of the *cyprinus* of Linnæus. See Cyprinus, Ichthyology *Index*.

ALCA, or Auk. See Ornithology *Index*.

ALCÆUS, a famous ancient lyric poet, born at Mitylene, in the iſland of Leſbos. Horace ſeems to think him the inventor of this kind of poeſy:

> Now the Roman muſe inſpire,
> And warm the ſong with Grecian fire. Francis.

He flouriſhed in the 44th Olympiad, at the ſame time with Sappho, who was likewiſe of Mitylene. Alcæus was a great enemy to tyrants, but not a very brave ſoldier. He was preſent at an engagement, wherein the Athenians gained a victory over the Leſbians; and here, as he himſelf is ſaid to have confeſſed in one of his pieces, he threw down his arms, and ſaved himſelf by flight. Horace, who, of all the Latin poets, moſt reſembled Alcæus, has made the like confeſſion:

> With thee I ſaw Philippi's plain,
> Its fatal rout, a fearful ſcene!
> And dropp'd, alas! th' inglorious ſhield,
> Where valour's ſelf was forc'd to yield;
> Where ſoil'd in duſt the vanquiſh'd lay,
> And breath'd th' indignant ſoul away. Francis.

The poetical abilities of Alcæus are indiſputable; and though his writings were chiefly in the lyric ſtrain, yet his muſe was capable of treating the ſublimeſt ſubjects with a ſuitable dignity. Hence Horace ſays,

> Alcæus ſtrikes the golden ſtrings,
> And ſeas, and war, and exile, ſings.
> Thus while they ſtrike the various lyre,
> The ghoſts the ſacred ſounds admire:
> But when Alcæus lifts the ſtrain
> To deeds of war and tyrants ſlain,
> In thicker crowds the ſhadowy throng
> Drink deeper down the martial ſong. Francis.

Alcæus, an Athenian tragic poet, and, as ſome think, the firſt compoſer of tragedies. He renounced his native country Mitylene, and paſſed for an Athenian. He left 10 pieces, one of which was Paſiphaë, that which he produced when he diſputed with Ariſtophanes, in the 4th year of the 97th Olympiad.

There is another Alcæus mentioned in Plutarch, perhaps the ſame whom Porphyrius mentions as a compoſer of ſatirical iambics and epigrams, and who wrote a poem concerning the plagiariſm of Euphorus the hiſtorian. He lived in the 145th Olympiad.

We are told likewiſe of one Alcæus, a Meſſenian, who lived in the reign of Veſpaſian and Titus. We know not which of theſe it was who ſuffered for his lewdneſs a very ſingular kind of death, which gave occaſion to the following epitaph:

Ἀλκαιȣ ταφος ȣτος, &c.

> This is Alcæus's tomb; who died by a radiſh,
> The daughter of the earth, and puniſher of Adulterers.

This puniſhment inflicted on adulterers, was thruſting one of the largeſt radiſhes up the anus of the adulterer: or, for want of radiſhes, they made uſe of a fiſh with a very large head, which Juvenal alludes to:

> *Quoſdam mœchos et mugilis intrat.* Sat. x.
> The mullet enters ſome behind.

Hence we may underſtand the menace of Catullus,

> *Ah! tum te miſerum, malique fati,*
> *Quem attractus pedibus, patente porta,*
> *Percurrent raphanique, mugileſque.* Epig. xv.
>
> Ah! wretched thou, and born to luckleſs fate,
> Who art diſcover'd by the unſhut gate!
> If once, alas! the jealous huſband come,
> The radiſh or the ſea-fiſh is thy doom.

ALCAICS, in *Ancient Poetry*, a denomination given to ſeveral kinds of verſe, from Alcæus, their inventor.

The firſt kind conſiſts of five feet, viz. a ſpondee, or iambic; an iambic; a long ſyllable; a dactyle; another dactyle: ſuch is the following verſe of Horace:

> *Omnes | eo|dem cogimur, | omnium*
> *Verſa|tur ur|na | ſerius | ocyus |*
> *Sors exitura.*

The ſecond kind conſiſts of two dactyles and two trochees: as,

> *Exili|um impoſi|tura | cymbæ.*

Beſides theſe two, which are called *dactylic Alcaïcs*, there is another ſtyled ſimply *Alcaïc*; conſiſting of an epitrite; a choriambus; another choriambus; and a bacchius: the following is of this ſpecies,

> *Cur timet fla|vum Tiberim tan|gere, cur | olivum?*

Alcaic Ode, a kind of manly ode compoſed of ſeveral ſtrophes, each conſiſting of four verſes; the two firſt of which are always Alcaïcs of the firſt kind; the third verſe is a diameter hypercatalectic, or conſiſting of four feet and a long ſyllable; and the fourth verſe is an Alcaïc of the ſecond kind. The following ſtrophe is is of this ſpecies, which Horace calls *minaces Alcæi camenæ.*

Non poſſidentem multa vocaveris
Recte beatum: rectius occupat
Nomen beati, qui deorum
Muneribus ſapienter uti, &c.

ALCAID, Alcayde, or Alcalde, in the polity of the Moors, Spaniards, and Portugueſe, a magiſtrate, or officer of juſtice, anſwering nearly to the French provoſt and the Britiſh juſtice of peace.—The alcaid among the Moors is veſted with ſupreme juriſdiction, both in civil and criminal caſes.

ALCALA de Guadeira, a ſmall town of Spain, in Andaluſia, upon the river Guadeira. Here are abundance of ſprings, from whence they convey water to Seville by an aqueduct. W. Long. 6. 16. N. Lat. 37. 15.

Alcala de Henares, a beautiful and large city of Spain, in New Caſtile, ſeated upon the river Henares, which waſhes its walls. It is built in a very agreeable plain, and is of an oval figure. The ſtreets are handſome and pretty ſtraight; one of them is very long, running from one end of the city to the other. The houſes are well built; and there are ſeveral ſquares, the largeſt of which is an ornament to the city; it is ſurrounded on all ſides with piazzas, where tradeſmen have their ſhops, to expoſe ſeveral ſorts of commodities to ſale, of which there is as great plenty and variety as in moſt towns of Spain. The univerſity was founded by Cardinal Ximenes, archbiſhop of Toledo, about the beginning of the 16th century. The land about Alcala is watered by the Henares, well cultivated, and very fruitful, while that at a diſtance is dry and ſterile: it yields grain in plenty, very good muſcat wine, and melons of a delicious kind. Without the walls is a ſpring, the water of which is ſo pure and ſo well taſted, that it is incloſed and ſhut up for the king of Spain's own uſe, from whence it is carried to Madrid.—This city is 10 miles ſouth-weſt of Guadalaxara, and 13 miles eaſt of Madrid. W. Long. 4. 20. N. Lat. 40. 30.

Alcala-Real, a ſmall city of Spain, in Andaluſia, with a fine abbey. It is built on the top of a high mountain, in a mountainous country; and the road to it is incommodious, rough, and unequal; but to make amends for this, here are ſeveral kinds of exquiſite fruit and wine. W. Long. 4. 15. N. Lat. 37. 18.

ALCALY, or Alcali, or Alkali. See Chemistry *Index*.

ALCANIS, a town of Arragon in Spain, ſeated on the river Guadaloupe, 12 miles from Caſpe. It was formerly the capital of the kingdom of the Moors; but being taken from them, it was made a commandery of the order of Calatrava. Here is a very remarkable fountain, which throws up water through 42 pipes. It is ſurrounded with gardens and fruit trees, and defended by a good fortreſs. W. Long. 0. 5. N. Lat. 41. 0.

ALCANNA, or Alkanna, in *Commerce*, a powder prepared from the leaves of the Egyptian privet, in which the people of Cairo drive a conſiderable trade. It is much uſed by the Turkiſh women to give a golden colour to their nails and hair. In dyeing, it gives a yellow colour when ſteeped with common water, and a red one when infuſed in vinegar. There is alſo an oil extracted from the berries of alcanna, which is ſometimes uſed in medicine.

ALCANTARA, a ſmall, but very ſtrong city of Eſtremadura, in Spain. It gives name to one of the three orders of knighthood. It is ſeated on the banks of the Tajo, or Tagus, 21 miles from Coria, in a very fruitful ſoil, and is celebrated for its bridge over that river. This was built in the time of the emperor Trajan, as appears by an inſcription over one of the arches, by the people of Luſitania, who were aſſeſſed to ſupply the expence. It is raiſed 200 feet above the level of the water; and though it conſiſts but of ſix arches, is 670 feet in length, and 28 in breadth. At the entrance of the bridge, there is a ſmall antique chapel hewn in a rock by the ancient Pagans, who dedicated it to Trajan, as the Chriſtians did to St Julian. This city was built by the Moors, on account of the convenience of this bridge; which is at a place where the Tajo is very deep, running between two high ſteep rocks: for this reaſon they called it *Al-Cantara*, which in their language, ſignifies *the Bridge*. It was taken from them in 1214, and given to the knights of *Calatrava*, who afterwards aſſumed the name of *Alcantara*. It was taken by the earl of Galway, in April, 1706, and retaken by the French in November following. It is 45 miles from Madrid, and 125 from Seville. W. Long. 7. 12.. N. Lat. 39. 30.

Knights of Alcantara, a military order of Spain, which took its name from the above-mentioned city. They make a very conſiderable figure in the hiſtory of the expeditions againſt the Moors. The knights of Alcantara make the ſame vows as thoſe of Calatrava, and are only diſtinguiſhed from them by this, that the croſs fleur de lys, which they bear over a large white cloak, is of a green colour. They poſſeſs 37 commanderies. By the terms of the ſurrender of Alcantara to this order, it was ſtipulated, that there ſhould be a confraternity between the two orders, with the ſame practices and obſervances in both; and that the order of Alcantara ſhould be ſubject to be viſited by the grand-maſter of Calatrava. But the former ſoon releaſed themſelves from this engagement, on pretence that their grand-maſter had not been called to the election of that of Calatrava, as had been likewiſe ſtipulated in the articles. After the expulſion of the Moors, and the taking of Granada, the ſovereignty of the order of Alcantara and that of Calatrava was ſettled in the crown of Caſtile by Ferdinand and Iſabella.—In 1540, the knights of Alcantara ſued for leave to marry, which was granted them.

ALCAREZ, a ſmall city of La Mancha, in Spain defended by a pretty ſtrong caſtle, and remarkable for an ancient aqueduct. It ſtands near the river Guardamena, and the ſoil about it is very fruitful. They have a breed of little running horſes, which are very fleet and ſtrong. It is 25 miles north of the confines of Andaluſia, 108 ſouth of Cuenza, and 138 ſouth by eaſt of Madrid. W. Long. 1. 50. N. Lat. 38. 28.

ALCASSAR do-sal, a town of Portugal, in Eſtremadura, which has a caſtle ſaid to be impregnable. It is indeed very ſtrong, both by art and nature, being built on the top of a rock which is exceedingly ſteep on all ſides. Here is a ſalt-work which produces very white ſalt, from whence the town takes its name. The fields

fields produce large quantities of a ſort of ruſhes, of which they make mats, which are tranſported out of the kingdom. W. Long. 9. 10. N. Lat. 38. 18.

Alcassar, a city of Barbary, ſeated about two leagues from Larache, in Aſga, a province of the kingdom of Fez. It was of great note, and the ſeat of the governor of this part of the kingdom. It was built by Jacob Almanzor, king of Fez, about the year 1180, and deſigned for a magazine and place of rendezvous for the great preparations he was making to enter Granada in Spain, and to make good the footing Joſeph Almanzor had got ſome time before. It is ſaid his father firſt invaded Spain with 300,000 men, moſt of whom he was obliged to bring back to Africa to quell a rebellion that had broke out in Morocco. This done, he returned to Spain again with an army, as is ſaid, of 200,000 horſe and 300,000 foot. The city is now fallen greatly to decay, ſo that of fifteen moſques there are only two that they make uſe of. The reaſon, probably, is the bad ſituation of the town; for it ſtands ſo low, that it is exceſſively hot in ſummer, and almoſt overflowed with water in the winter. This they affirm to be owing to a curſe of one of their ſaints. Here are a great number of ſtorks, who live very familiarly with the people, walking about the town, poſſeſſing the tops of the houſes and moſques without moleſtation; for they eſteem them ſacred birds, and account it ſinful to diſturb them. At preſent, the baſhaw of Tetuan appoints a governor to this town, which is the laſt of his dominions towards Mequinez. Near this city there is a high ridge of mountains, running towards Tetuan, whoſe inhabitants were never brought entirely under ſubjection; and whenever it was attempted, they revenged themſelves by infeſting the roads, and robbing and deſtroying the travellers. When they were purſued, they retired into their woody mountains, where none could ſafely follow them. Not far from hence is the river Elmahaſſen, famous for the battle fought between Don Sebaſtian king of Portugal and the Moors; in which the Portugueſe were defeated and their king ſlain. W. Long. 12. 35. N. Lat. 35. 15.

ALCAVALA, in the *Spaniſh Finances*, was at firſt a tax of 10 *per cent.* afterwards of 14 *per cent.* and is at preſent of only 6 *per cent.* upon the ſale of every ſort of property, whether moveable or immoveable; and it is repeated every time the property is ſold. The levying of this tax requires a multitude of revenue-officers ſufficient to guard the tranſportation of goods, not only from one province to another, but from one ſhop to another. It ſubjects not only the dealers in ſome ſorts of goods, but thoſe in all ſorts, every farmer, every manufacturer, every merchant and ſhopkeeper, to the continual viſits and examination of the tax-gatherers. Through the greater part of a country in which a tax of this kind is eſtabliſhed, nothing can be produced for diſtant ſale. The produce of every part of the country muſt be proportioned to the conſumption of the neighbourhood. It is to the Alcavala, accordingly, that Uſtaritz imputes the ruin of the manufactures of Spain. He might have imputed to it likewiſe the declenſion of agriculture, it being impoſed not only upon manufactures, but upon the rude produce of the land.

ALCAZAR leguer, a town of Africa, in the kingdom of Fez, and in the province of Habat. It was taken by Alphonſo, king of Portugal, in 1468; but ſoon after that, it was abandoned to the Moors. It is ſeated on the coaſt of the ſtraits of Gibraltar. W. Long. 3. 50. N. Lat. 38. 0.

ALCAZER, a town of Spain, in New Caſtile, ſeated on the river Guardamena, which has a fortreſs on a high hill for its defence, and lies in a very fruitful country. It is 100 miles north-weſt of Carthagena. W. Long. 2. 10. N. Lat. 38. 15.

ALCE, Alces, or Elk, in *Zoology*, the trivial name of a ſpecies of the cervus, belonging to the order of mammalia pecora. See Cervus.

ALCEA, the Holly-Hock. See Botany *Index*.

ALCEDO, or Kingsfisher. See Ornithology *Index*.

ALCHEMILLA, or Ladies-mantle. See Botany *Index*.

ALCHEMIST, a practitioner in alchemy.

ALCHEMY, that branch of chemiſtry which had for its principal objects the tranſmutation of metals into gold; the panacea, or univerſal remedy; an alkaheſt, or univerſal menſtruum; an univerſal ferment; and many other things equally ridiculous.

Kircher, inſtructed in all the ſecrets of chemiſtry, has fully expoſed the artifices and impoſtures of alchemiſts. An alchemiſt puts into a crucible the matter which is to be converted into gold: this he ſets on the fire, blows it, ſtirs it with rods; and, after divers operations, gold is found at the bottom of the crucible, inſtead of the matter firſt put in. This there are a thouſand ways of effecting, without any tranſmutation. Sometimes it is done by dexterouſly dropping in a piece of gold concealed between the fingers, ſometimes by caſting in a little of the duſt of gold or ſilver diſguiſed under the appearance of ſome elixir, or other indifferent matter; ſometimes a crucible is uſed which has a double bottom, and gold put between the two; ſometimes the rod uſed to ſtir the matter is hollow, and filled with the duſt of the metal deſired; at other times there is metal mixed with the charcoal, the aſhes of the furnace, or the like. Mr Harris very properly diſtinguiſhes alchemy from chemiſtry; and defines the former to be *ars ſine arte, cujus principium eſt mentiri, medium laborare, et finis mendicare;* and the Italians have a proverb, *non ti fidiare al alchemiſta povero o medico amalato.* The ruin which has attended this deluſion has occaſioned ſeveral ſtates to make ſevere laws againſt pretences to alchemy. The Romans formerly baniſhed all ſuch as profeſſed it; and the ſacred canons likewiſe directed the thunder of their cenſure againſt them. Diocleſian and Cæſar directed all books which treated of this ſubject to be burnt. Rymer furniſhes us with a licenſe for practiſing alchemy, with all kinds of metals and minerals, granted to one Richard Carter in 1476; *Rym. Fœd.* tom. xii. Nevertheleſs, we have had ſevere laws againſt alchemy, and multiplying of metals, as much ſo as againſt coining itſelf.

ALCHORNEA. See Botany *Index*.

ALCIAT or Alciate, Andrew, a great lawyer, who flouriſhed in the 16th century, was born at Milan. He mixed much of polite learning in the explication of the laws, and happily drove out the barbarity of language which till then had reigned in the lectures and writings of lawyers; for which Thuanus highly praiſes praifes him. He publifhed a great many law-books, and fome notes upon Tacitus. His Emblems have been much admired, and tranflated into French, Italian, and Spanifh; and feveral learned men have written commentaries on them.

ALCIBIADES, an Athenian general. It was the fate of this great man to live at a time when his country was a fcene of confufion. The Greeks, grown infolent from their conquefts in Perfia, turned their armies againft each other, and bandied together under the conduct of the two moft opulent ftates, Athens and Lacedæmon. Alcibiades, in the midft of an expedition he had planned againft the enemies of his country, was recalled home to anfwer fome charge of a private nature; but fearing the violence of his enemy, inftead of going to Athens, he offered his fervices at Sparta, where they were readily accepted. By his advice the Lacedæmonians made a league with Perfia, which gave a very favourable turn to their affairs. But his credit in the republic raifing jealoufies againft him, he privately reconciled himfelf to his country, and took again the command of an Athenian army. Here victory, waiting as it were at his command, attended all his motions. The lofs of feven battles obliged the Spartans to fue for peace. He enjoyed his triumphs, however, only a fhort time at Athens. One unfuccefsful event made him again obnoxious to the malice of his citizens; and he found it expedient to retire from Athens. In his abfence the Spartans again took the lead, and at the fatal battle of Ægos entirely fubdued the Athenian power. Alcibiades, though an exile, endeavoured to reftore the power of his country; of which the Spartans having intelligence, procured him to be affaffinated. He was a man of admirable accomplifhments, but indifferently principled; of great parts; and of an amazing verfatility of genius.

ALCINOUS, king of the Phæacians, in the ifland now called *Corfu*, was fon of Naufithous, and grandfon of Neptune and Peribea. It is by his gardens this king has chiefly immortalized his memory. He received Ulyffes with much civility, when a ftorm had caft him on his coaft. The people here loved pleafure and good cheer, yet were fkilful feamen; and Alcinous was a good prince.

ALCMAER, a city of the United Provinces, feated in North Holland, about four miles from the fea, 15 from Haerlem, and 18 from Amfterdam. It is a handfome city, and one of the cleaneft in Holland. The ftreets and houfes are extremely neat and regular, and the public buildings very beautiful. It had formerly two parifh-churches, dedicated to St Matthew and St Lawrence. The latter had fo high a tower, that it ferved for a fea mark to the veffels that were in the open fea; but, in 1464, it tumbled down, and damaged the other church fo much, that they were both demolifhed in 1670, and one church was built in their ftead, dedicated to the fame faints. The Spaniards, under the command of Frederic of Toledo, fon of the duke of Alva, came to befiege it, after they had taken Haerlem in 1573; but were forced to raife the fiege, after three months lying before it, as well on account of the infection of the air as the ftout refiftance of the inhabitants and foldiers; even the women fignalizing themfelves bravely in its defence. It is recorded in the regifter of this city, that, in the year 1637, 120 tulips, with the offsets, fold for 90,000 florins. The town has a very good trade in butter and cheefe, of which a vaft quantity is fold every year, and is efteemed the beft in Holland. E. Long. 4. 26. N. Lat. 52. 28.

ALCMAN, a lyric poet, who flourifhed in the 27th Olympiad, about 670 years before Chrift. He was born at Sparta; and compofed feveral poems, of which only fome fragments are remaining, quoted by Athenæus and fome other ancient writers. He was very amorous; accounted the father of gallant poefy; and is faid to have been the firft that introduced the cuftom of finging love fongs in company. He is reported to have been one of the greateft eaters of his age; upon which Mr Bayle remarks, that fuch a quality would have been extremely inconvenient, if poetry had been at that time upon fuch a footing as it has been often fince, not able to procure the poet bread. He died of a ftrange difeafe; for he was eaten up with lice.

ALCMANIAN, in *Ancient Lyric Poetry*, a kind of verfe confifting of two dactyles and two trochees; as,—

Virgini|bus pue|rifque|canto.

The word is formed from *Alcman*, the name of an ancient Greek poet, in great efteem for his erotics or amorous compofitions.

ALCMENA, the daughter of Electryo king of Mycenæ, and wife of Amphitryon. Jupiter putting on the fhape of her hufband while he was abroad in the wars, begot Hercules upon her: he made that night as long as three ordinary ones.

ALCOCK, John, doctor of laws, and bifhop of Ely in the reign of King Henry VII. was born at Beverly in Yorkfhire, and educated at Cambridge. He was firft made dean of Weftminfter, and afterwards appointed mafter of the rolls. In 1471, he was confecrated bifhop of Rochefter: in 1476, he was tranflated to the fee of Worcefter; and in 1486, to that of Ely, in the room of Dr John Morton, preferred to the fee of Canterbury. He was a prelate of great learning and piety; and fo highly efteemed by King Henry, that he appointed him lord prefident of Wales, and afterwards lord chancellor of England. Alcock founded a fchool at Kingfton upon Hull, and built the fpacious hall belonging to the epifcopal palace at Ely. He was alfo the founder of Jefus-college in Cambridge, for a mafter, fix fellows, and as many fcholars. This houfe was formerly a nunnery, dedicated to St Radigund: and, as Godwin tells us, the building being greatly decayed, and the revenues reduced almoft to nothing, the nuns had all forfaken it, except two; whereupon Bifhop Alcock procured a grant from the crown, and converted it into a college. But Camden and others tell us, that the nuns of that houfe were fo notorious for their incontinence, that King Henry VII. and Pope Julius II. confented to its diffolution: Bale accordingly calls this nunnery *fpiritualium meretricum cænobium*, "a community of fpiritual harlots." Bifhop Alcock wrote feveral pieces; amongft which are the following: 1. *Mons Perfectionis.* 2. *In Pfalmos Penitentiales.* 3. *Homiliæ Vulgares.* 4. *Meditationes Piæ.* He died October 1. 1500; and was buried in the chapel he had built at Kingfton upon Hull.

ALCOHOL, or Alkool, in *Chemiftry*, fpirit of wine highly rectified. It is alfo ufed for any highly rectified

rectified spirit.—Alcohol is extremely light and inflammable: It is a strong antiseptic, and therefore employed to preserve animal substances. See CHEMISTRY *Index*.

ALCOHOL is also used for any fine impalpable powder.

ALCOHOLIZATION, the process of rectifying any spirit. It is also used for pulverization.

ALCOR, in *Astronomy*, a small star adjoining to the large bright one in the middle of the tail of *ursa major*.—The word is Arabic. It is a proverb among the Arabians, applied to one who pretends to see small things, but overlooks much greater: *Thou canst see Alcor, and yet not see the full moon.*

ALCORAN, or AL-KORAN, the scripture, or bible of the Mahometans. The word is compounded of the Arabic particle *al*, and *coran* or *koran*, derived from the verb *caraa* or *karaa*, to read. The word therefore properly signifies, *the reading;* or rather, *that which ought to be read.* By this name the Mahometans denote not only the entire book or volume of the Koran, but also any particular chapter or section of it; just as the Jews call either the whole Scripture, or any part of it, by the name of *Karah*, or *Mikra*, words of the same origin and import.

Besides this peculiar name, the Koran is also honoured with several appellations common to other books of Scripture: as, *al Farkan*, from the verb *faraka*, *to divide* or *distinguish;* not, as the Mahometan doctors say, because those books are divided into chapters or sections, or distinguish between good and evil; but in the same notion that the Jews use the word *Perek*, or *Pirka*, from the same root, to denote a section or portion of Scripture. It is also called *al Moshaf*, *the volume*, and *al Kitab*, *the book*, by way of eminence, which answers to the *Biblia* of the Greeks; and *al Dhikr*, *the admonition*, which name is also given to the Pentateuch and Gospel.

The Koran is divided into 114 larger portions of very unequal length, which we call *chapters;* but the Arabians *sowar*, in the singular *sura*, a word rarely used on any other occasion, and properly signifying a row, order, or a regular series; as a course of bricks in building, or a rank of soldiers in an army; and is the same in use and import with the Sura, or Tora, of the Jews, who also call the fifty three sections of the Pentateuch *Sedarim*, a word of the same signification.

These chapters are not, in the manuscript copies, distinguished by their numerical order, but by particular titles, which are taken sometimes from a particular matter treated of, or person mentioned therein; but usually from the first word of note, exactly in the same manner as the Jews have named their Sedarim; though the word from which some chapters are denominated be very far distant, towards the middle, or perhaps the end, of the chapter; which seems ridiculous. But the occasion of this appears to have been, that the verse or passage wherein such word occurs, was, in point of time, revealed and committed to writing before the other verses of the same chapter which precede it in order; and the title being given to the chapter before it was completed, or the passages reduced to their present order, the verse from whence such title was taken did not always happen to begin the chapter. Some chapters have two or more titles, occasioned by the difference of the copies.

Some of the chapters having been revealed at Mecca, and others at Medina, the noting this difference makes a part of the title: but the reader will observe, that several of the chapters are said to have been revealed partly at Mecca and partly at Medina; and, as to others, it is yet a dispute among the commentators to which of the two places they belong.

Every chapter is subdivided into smaller portions, of very unequal length also, which we customarily call *verses:* but the Arabic word is *ayat*, the same with the Hebrew *ototh*, and signifies *signs* or *wonders:* such as are the secrets of God, his attributes, works, judgements, and ordinances, delivered in those verses; many of which have their particular titles also, imposed in the same manner as those of the chapters.

Besides these unequal divisions of chapter and verse, the Mahometans have also divided their Koran into sixty equal portions, which they call *Ahzab*, in the singular *Hizb*, each subdivided into four equal parts; which is also an imitation of the Jews, who have an ancient division of their Mishna into sixty portions called *Massictoth*. But the Koran is more usually divided into thirty sections only, named *Ajza*, from the singular *Joz*, each of twice the length of the former, and in the like manner subdivided into four parts. These divisions are for the use of the readers of the Koran in the royal temples, or in the adjoining chapels where the emperors and great men are interred. There are thirty of these readers belonging to every chapel, and each reads his section every day; so that the whole Koran is read over once a-day.

Next after the title, at the head of every chapter, except only the ninth, is prefixed the following solemn form, by the Mahometans called the *Bismallah*, IN THE NAME OF THE MOST MERCIFUL GOD; which form they constantly place at the beginning of all their books and writings in general, as a peculiar mark or distinguishing characteristic of their religion, it being counted a sort of impiety to omit it. The Jews, for the same purpose, make use of the form, *In the name of the* LORD, or, *In the name of the great* GOD; and the eastern Christians that of, *In the name of the Father, and of the Son, and of the Holy Ghost.* But Mahomet probably took this form, as he did many other things, from the Persian Magi, who used to begin their books in these words, *Benam Yezdan bakshaishgher dadar;* that is, *In the name of the most merciful just* GOD.

There are twenty-nine chapters of the Koran, which have this peculiarity, that they begin with certain letters of the alphabet, some with a single one, others with more. These letters the Mahometans believe to be the peculiar marks of the Koran, and to conceal several profound mysteries; the certain understanding of which, the more intelligent confess, has not been communicated to any mortal, their prophet only excepted. Notwithstanding which, some will take the liberty of guessing at their meaning by that species of Cabala called by the Jews *Notarikon*, and suppose the letters to stand for as many words, expressing the names and attributes of God, his works, ordinances, and decrees; and therefore these mysterious letters, as well as the verses

verſes themſelves, ſeem in the Koran to be called *ſigns.* Others explain the intent of theſe letters from their nature or organ, or elſe from their value in numbers, according to another ſpecies of the Jewiſh Cabala called *Gematria;* the uncertainty of which conjectures ſufficiently appears from their diſagreement. Thus, for example, five chapters, one of which is the ſecond, begins with theſe letters, A. L. M. which ſome imagine to ſtand for *Allah latiff magid,* "God *is gracious and to be glorified;*" or, *Ana li minni,* i. e. *to me and from me,* viz. belongs all perfection, and proceeds all good; or elſe for *Ana Allah alam,* "*I am the moſt wiſe* God," taking the firſt letter to mark the beginning of the firſt word, the ſecond the middle of the ſecond word, and the third the laſt of the third word; or for *Allah, Gabriel, Mohammed,* the author, revealer, and preacher of the Koran. Others ſay, that as the letter A belongs to the lower part of the throat, the firſt of the organs of ſpeech; L to the palate; the middle organ; and M to the lips, which are the laſt organ; ſo theſe letters ſignify that God is the beginning, middle, and end, or ought to be praiſed in the beginning, middle, and end, of all our words and actions: or, as the total value of thoſe three letters, in numbers is ſeventy-one, they ſignify, that, in the ſpace of ſo many years, the religion preached in the Koran ſhould be fully eſtabliſhed. The conjecture of a learned Chriſtian is at leaſt as certain as any of the former, who ſuppoſes thoſe letters were ſet there by the amanuenſis, for *Amar li Mohammed,* i. e. *at the command of Mohammed,* as the five letters prefixed to the nineteenth chapter ſeem to be there written by a Jewiſh ſcribe, for *Coh yaas,* i. e. *Thus he commanded.*

The Koran is univerſally allowed to be written with the utmoſt elegance and purity of language, in the dialect of the tribe of Koreiſh, the moſt noble and polite of all the Arabians, but with ſome mixture, though very rarely, of other dialects. It is confeſſedly the ſtandard of the Arabic tongue, and, as the more orthodox believe, and are taught by the book itſelf, inimitable by any human pen (though ſome ſectaries have been of another opinion), and therefore inſiſted on as a permanent miracle, greater than that of raiſing the dead, and alone ſufficient to convince the world of its divine original.

And to this miracle did Mahomet himſelf chiefly appeal for the confirmation of his miſſion, publicly challenging the moſt eloquent men in Arabia, which was at that time ſtocked with thouſands whoſe ſole ſtudy and ambition it was to excel in elegance of ſtyle and compoſition, to produce even a ſingle chapter that might be compared with it (A).

To the pomp and harmony of expreſſion ſome aſcribe all the force and effect of the Alcoran; which they conſider as a ſort of muſic, equally fitted with other ſpecies of that art to raviſh and amaze. In this Mahomet ſucceeded ſo well, and ſo ſtrangely captivated the minds of his audience, that ſeveral of his opponents thought it the effect of witchcraft and enchantment, as he himſelf complains.—Others have attributed the effect of the Alcoran to the frequent mention of rewards and puniſhments; heaven and hell occurring almoſt in every page. Some ſuppoſe, that the ſenſual pleaſures of paradiſe, ſo frequently ſet before the imaginations of the readers of the Alcoran, were what chiefly bewitched them. Though, with regard to theſe, there is a great diſpute whether they are to be underſtood literally or ſpiritually. Several have even allegorized the whole book.

The general deſign of the Koran was to unite the profeſſors of the three different religions, then followed in the populous country of Arabia (who for the moſt part lived promiſcuouſly, and wandered without guides, the far greater number being idolaters, and the reſt Jews and Chriſtians moſtly of erroneous and heterodox belief), in the knowledge and worſhip of one God, under the ſanction of certain laws, and the outward ſigns of ceremonies partly of ancient and partly of novel inſtitution, enforced by the conſideration of rewards and puniſhments both temporal and eternal; and to bring them all to the obedience of Mahomet, as the prophet and ambaſſador of God, who, after the repeated admonitions, promiſes, and threats, of former ages, was at laſt to eſtabliſh and propagate God's religion on earth, and to be acknowledged chief pontiff in ſpiritual matters, as well as ſupreme prince in temporal.

The great doctrine then of the Koran, is the unity of God; to reſtore which point Mahomet pretended was the chief end of his miſſion; it being laid down by him as a fundamental truth, That there never was, nor ever can be, more than one true orthodox religion. For, though the particular laws or ceremonies are only temporary, and ſubject to alteration, according to the divine direction; yet the ſubſtance of it being eternal truth, is not liable to change, but continues immutably the ſame. And he taught, that, whenever this religion became neglected, or corrupted in eſſentials, God had the goodneſs to re-inform and re-admoniſh mankind thereof, by ſeveral prophets, of whom Moſes and Jeſus were the moſt diſtinguiſhed, till the appearance of Mahomet, who is their ſeal, and no other to be expected after him. The more effectually to engage people to hearken to him, great part of the Koran is employed in relating examples of dreadful puniſhments formerly inflicted by God on thoſe who rejected and abuſed his meſſengers; ſeveral of which ſtories, or ſome circumſtances of them, are taken from the Old and New Teſtaments, but many more from the apocryphal books and traditions of the Jews and Chriſtians of thoſe ages, ſet up in the Koran as truths in oppoſition to the Scriptures, which the Jews and Chriſtians are charged with having altered: and indeed, few or none of the relations or circumſtances in the Koran were invented by Mahomet, as is generally ſuppoſed, it being eaſy to trace the greateſt part of them

(A) As the compoſition and arrangement of words, however, admit of infinite varieties, it can never be abſolutely ſaid that any one is the beſt poſſible. In fact, Hamzah Benahmed wrote a book againſt the Alcoran with at leaſt equal elegance; and Moſelema another, which even ſurpaſſed it, and occaſioned a defection of a great part of the Muſſulmans. *Journ. de Sçav.* tom. xiii. p. 280. *Oeuvr. de Sçav.* Nov. 1708, p. 404.

them much higher, as the rest might be, were more of those books extant, and was it worth while to make the inquiry.

The rest of the Alcoran is taken up in prescribing necessary laws and directions, frequent admonitions to moral and divine virtues, the worship and reverence of the Supreme Being, and resignation to his will. One of their most learned commentators distinguishes the contents of the Alcoran into *allegorical* and *literal*; under the former are comprehended all the obscure, parabolical, and enigmatical passages, with such as are repealed, or abrogated; the latter, such as are clear, and in full force.

The most excellent moral in the whole Alcoran, interpreters say, is that in the chapter *Al Alraf*, viz. "Shew mercy, do good to all, and dispute not with the ignorant;" or, as Mr Sale renders it, "Use indulgence, command that which is just, and withdraw far from the ignorant." Mahomet, according to the authors of the *Keschaf*, having begged of the angel Gabriel a more ample explication of this passage, received it in the following terms: "Seek him who turns thee out, give to him who takes from thee, pardon him who injures thee; for God will have you plant in your souls the roots of his chief perfections." It is easy to see that this commentary is copied from the gospel. In reality, the necessity of forgiving enemies, though frequently inculcated in the Alcoran, is of a later date among the Mahometans than among the Christians; among those latter, than among the heathens; and to be traced originally among the Jews. (See Exodus xxiii. 4. 5.) But it matters not so much who had it first, as who observes it best. The caliph Hassan, son of Hali, being at table, a slave unfortunately let fall a dish of meat reeking hot, which scalded him severely. The slave fell on his knees, rehearsing these words of the Alcoran, "Paradise is for those who restrain their anger." I am not angry with thee, answered the caliph.—"And for those who forgive offences against them," continues the slave. I forgive thee thine, replies the caliph.—"But above all, for those who return good for evil," adds the slave. I set thee at liberty, rejoined the caliph; and I give thee ten dinars.

There are also a great number of occasional passages in the Alcoran, relating only to particular emergencies. For this advantage Mahomet had in the piecemeal method of receiving his revelation, that whenever he happened to be perplexed and gravelled with any thing, he had a certain resource in some new morsel of revelation. It was an admirable contrivance of his, to bring down the whole Alcoran at once, only to the lowest heaven, not to earth; since, had the whole been published at once, innumerable objections would have been made, which it would have been impossible for him to solve; but as he received it by parcels, as God saw fit they should be published for the conversion and instruction of the people, he had a sure way to answer all emergencies, and to extricate himself with honour from any difficulty which might occur.

It is the general and orthodox belief among the Mahometans, that the Koran is of divine original; nay, that it is eternal and uncreated, remaining, as some express it, in the very essence of God: that the first transcript has been from everlasting by God's throne, written on a table of vast bigness, called the *preserved table*, in which are also recorded the divine decrees past and future: that a copy from this table, in one volume on paper, was by the ministry of the angel Gabriel sent down to the lowest heaven, in the month of Ramadan, on the night of *power*: from whence Gabriel revealed it to Mahomet by parcels, some at Mecca, and some at Medina, at different times, during the space of 23 years, as the exigency of affairs required; giving him, however, the consolation to show him the whole (which they tell us was bound in silk, and adorned with gold and precious stones of paradise) once a-year; but in the last year of his life he had the favour to see it twice. They say, that few chapters were delivered entire, the most part being revealed piecemeal, and written down from time to time by the prophet's amanuensis in such a part of such and such a chapter, till they were completed, according to the directions of the angel. The first parcel that was revealed is generally agreed to have been the first five verses of the 96th chapter.

After the new-revealed passages had been from the prophet's mouth taken down in writing by his scribe, they were published to his followers; several of whom took copies for their private use, but the far greater number got them by heart. The originals, when returned, were put promiscuously into a chest, observing no order of time; for which reason it is uncertain when many passages were revealed.

When Mahomet died, he left his revelations in the same disorder, and not digested into the method, such as it is, in which we now find them. This was the work of his successor Abu Becr; who, considering that a great number of passages were committed to the memory of Mahomet's followers, many of whom were slain in their wars, ordered the whole to be collected, not only from the palm-leaves and skins on which they had been written, and which were kept between two boards or covers, but also from the mouths of such as had gotten them by heart. And this transcript, when completed, he committed to the custody of Hassa the daughter of Omar, one of the prophet's widows.

From this relation it is generally imagined that Abu Becr was really the compiler of the Koran; though, for aught appears to the contrary, Mahomet left the chapters complete as we now have them, excepting such passages as his successor might add or correct from those who had gotten them by heart; what Abu Becr did else, being perhaps no more than to range the chapters in their present order, which he seems to have done without any regard to time, having generally placed the longest first.

However, in the 30th year of the Hegira, Othman being then caliph, and observing the great disagreement in the copies of the Koran in the several provinces of the empire: those of Irak, for example, following the reading of Abu Musa al Ashari, and the Syrians that of Macdad Ebn Aswad; he, by the advice of the *companions*, ordered a great number of copies to be transcribed from that of Abu Becr, in Hassa's care, under the inspection of Zeid Ebn Thabet, Abd'allah Ebn Zobair, Said Ebn al As, and Abd'alrahman Ebn al Hareth the Makhzumite; whom he directed, that, wherever they disagreed about any word, they should write it in the dialect of the Koreish, Alcoran.

reifh, in which it was at firft delivered. Thefe copies, when made, were difperfed in the feveral provices of the empire, and the old ones burnt and fuppreffed. Though many things in Haffa's copy were corrected by the above-mentioned revifers, yet fome few various readings ftill occur.

In fine, the book of the Alcoran is held in the higheft efteem and reverence among the Muffelmans. They dare not fo much as touch the Alcoran without being firft wafhed, or legally purified; to prevent which, an infcription is put on the cover or label, *Let none touch but they who are clean.* It is read with great care and refpect; being never held below the girdle. They fwear by it; take omens from it on all weighty occafions; carry it with them to war; write fentences of it in their banners; adorn it with gold and precious ftones; and knowingly fuffer it not to be in the poffeffion of any of a different religion. Some fay that it is punifhable even with death, in a Chriftian, to touch it; others, that the veneration of the Muffulmans leads them to condemn the tranflating it into any other language as a profanation: but thefe feem to be aggravations. The Mahometans have taken care to have their Scripture tranflated into the Perfian, the Javanefe, the Malayan, and other languages; though, out of refpect to the original, thefe verfions are generally, if not always, interlineated.

View of Chriftianity and Mahometanifm, p. 257.

By the advocates of Mahometanifm, the Koran, as already obferved, has always been held forth as the greateft of miracles, and equally ftupendous with the act of raifing the dead. The miracles of Mofes and Jefus, they fay, were tranfient and temporary; but that of the Koran is permanent and perpetual; and therefore far furpaffes all the miraculous events of preceding ages. We will not detract from the real merit of the Koran: we allow it to be generally elegant, and often fublime: but at the fame time we reject with difdain its arrogant pretence to any thing fupernatural; all the real excellence of the work being eafily referable to natural and vifible caufes.

" In the language of Arabia, a language extremely loved and diligently cultivated by the people to whom it was vernacular, Mahomet found advantages which were never enjoyed by any former or fucceeding impoftor. It requires not the eye of a philofopher to difcover in every foil and country a principle of national pride: and if we look back for many ages on the hiftory of the Arabians, we fhall eafily perceive that pride among them invariably to have confifted in the knowledge and improvement of their native language. The Arabic, which has been juftly efteemed the moft copious of the Eaftern tongues; which had exifted from the remoteft antiquity; which had been embellifhed by numberlefs poets, and refined by the conftant exercife of the natives; was the moft fuccefsful inftrument which Mahomet employed in planting his new religion among them. Admirably adapted by its unrivalled harmony, and by its endlefs variety to add painting to expreffion, and to purfue the imagination in its unbounded flight; it became in the hands of Mahomet an irrefiftible charm to blind the judgment, and to captivate the fancy of his followers.

" Of that defcription of men, who firft compofed the adherents of Mahomet, and to whom the Koran was addreffed, few, probably, were able to pafs a very accurate judgment on the propriety of the fentiments, or on the beauties of the diction: but all could judge of the military abilities of their leader; and in the midft of their admiration it is not difficult to conceive, that they would afcribe to his compofitions every imaginary beauty of infpired language.

" The fhepherd and the foldier, though awake to the charms of thofe wild but beautiful compofitions, in which were celebrated their favourite occupations of love or war, were yet little able to criticife any other works than thofe which were addreffed to the imagination or the heart. To abftract reafonings on the attributes and the difpenfations of the Deity, to the comparative excellencies of rival religions, to the confiftency of any one religious fyftem in all its parts, and to the force of its various proofs, they were quite inattentive. In fuch a fituation, the appearance of a work which poffeffed fomething like wifdom and confiftence; which prefcribed the rules, and illuftrated the duties of life; and which contained the principles of a new and comparatively fublime theology, independently of its real and permanent merit, was likely to excite their aftonifhment, and to become the ftandard of future compofition.

" In the firft periods of the literature of every country, fomething of this kind has happened. The father of Grecian poetry very obvioufly influenced the tafte and imitation of his countrymen. The modern nations of Europe all poffefs fome original author, who, rifing from the darknefs of former ages, has begun the career of compofition, and tinctured with the character of his own imagination the ftream which has flowed through his pofterity.

" But the prophet of Arabia had in this refpect advantages peculiar to himfelf. His compofitions were not to his followers the works of man, but the genuine language of Heaven, which had fent him. They were not confined therefore to that admiration which is fo liberally beftowed on the earlieft productions of genius, or to that fond attachment with which men everywhere regard the original compofitions of their country: but with their admiration they blended their piety. To know and to feel the beauties of the Koran, was in fome refpect to fhare in the temper of heaven; and he who was moft affected with admiration in the perufal of its beauties, feemed moft fitly the object of that mercy which had given it to ignorant man. The Koran, therefore, became naturally and neceffarily the ftandard of tafte. With a language thus hallowed in their imaginations, they were too well fatisfied, either to difpute its elegance or improve its ftructure. In fucceeding ages, the additional fanction of antiquity, or prefcription, was given to thefe compofitions which their fathers had admired: and while the belief of its divine original continues, that admiration, which has thus become the teft and the duty of the faithful, can neither be altered nor diminifhed.

" When therefore we confider thefe peculiar advantages of the Koran, we have no reafon to be furprifed at the admiration in which it is held. But if, defcending to a more minute inveftigation of it, we confider its perpetual inconfiftence and abfurdity, we fhall indeed have caufe for aftonifhment at that weaknefs of humanity which could ever have received fuch compofitions as the work of the Deity.

" The

Alcoran.

" The first praise of all the productions of genius, is invention; that quality of the mind, which, by the extent and quickness of its views, is capable of the largest conceptions, and of forming new combinations of objects the most distant and unusual. But the Koran bears little impression of this transcendent character. Its materials are wholly borrowed from the Jewish and Christian Scriptures, from the Talmudical legends and apocryphal gospels then current in the East, and from the traditions and fables which abounded in Arabia. The materials collected from these several sources are here heaped together, with perpetual and needless repetitions, without any settled principle or visible connection.

" When a great part of the life of Mahomet had been spent in preparatory meditation on the system he was about to establish, its chapters were dealt out slowly and separately during the long period of 23 years. Yet thus defective in its structure, and not less exceptionable in its doctrines, was the work which Mahomet delivered to his followers as the oracles of God.

" The most prominent feature of the Koran, that point of excellence in which the partiality of its admirers has ever delighted to view it, is the sublime notion it generally impresses of the nature and attributes of God. If its author had really derived these just conceptions from the inspiration of that Being whom they attempt to describe, they would not have been surrounded, as they now are on every side, with error and absurdity. But it might easily be proved, that whatever it justly defines of the divine attributes, was borrowed from our Holy Scripture; which even from its first promulgation, but especially from the completion of the New Testament, has extended the views and enlightened the understandings of mankind; and thus furnished them with arms, which have too often, though ineffectually, been turned against itself by its ungenerous enemies.

" In this instance particularly, the copy is far below the great original, both in the propriety of its images, and the force of its descriptions. Our Holy Scriptures are the only compositions that can enable the dim sight of mortality to penetrate into the invisible world, and to behold a glimpse of the Divine perfections. Accordingly, when they would represent to us the happiness of Heaven, they describe it, not by any thing minute and particular, but by something general and great; something that, without descending to any determinate object, may at once by its beauty and immensity excite our wishes and elevate our affections. Though in the prophetical and evangelical writings the joys that shall attend us in a future state are often mentioned with ardent admiration, they are expressed rather by allusion than similitude, rather by indefinite and figurative terms, than by any thing fixed and determinate. 'Eye hath not seen, nor ear heard, neither have entered into the heart of man, the things which God hath prepared for them that love him.' 1. *Cor.* ii. 9. What a reverence and astonishment does this passage excite in every hearer of taste and piety! What energy, and at the same time what simplicity, in the expression! How sublime, and at the same time how obscure, is the imagery!

" Different was the conduct of Mahomet in his descriptions of heaven and of paradise. Unassisted by the necessary influence of virtuous intentions and Divine inspiration, he was neither desirous, nor indeed able, to exalt the minds of men to sublime conceptions, or to rational expectations. By attempting to explain what is inconceivable, to describe what is ineffable, and to materialize what in itself is spiritual; he absurdly and impiously aimed to sensualize the purity of the Divine essence. Thus he fabricated a system of incoherence, a religion of depravity, totally repugnant indeed to the nature of that Being, who, as he pretended, was its object; but therefore more likely to accord with the appetites and conceptions of a corrupt and sensual age.

Alcoran.

" That we may not appear to exalt our Scriptures thus far above the Koran by an unreasonable preference, we shall produce a part of the second chapter of the latter, which is deservedly admired by the Mahometans, who wear it engraved on their ornaments, and recite it in their prayers. 'God! there is no God but he; the living, the self-subsisting: neither slumber nor sleep seizeth him: to him belongeth whatsoever is in heaven, and on earth. Who is he that can intercede with him but through his good pleasure? He knoweth that which is past, and that which is to come. His throne is extended over heaven and earth, and the preservation of both is to him no burden. He is the high, the mighty.' *Sale's Kor.* ii. p. 30. 4to edit.

" To this description who can refuse the praise of magnificence? Part of that magnificence, however, is to be referred to that verse of the Psalmist, whence it was borrowed, 'He that keepeth Israel, shall neither slumber nor sleep.' *Psal.* cxxi. 4.

" But if we compare it with that other passage of the same inspired Psalmist, all its boasted grandeur is at once obscured, and lost in the blaze of a greater light.

" O my God, take me not away in the midst of my days; thy years are throughout all generations. Of old hast thou laid the foundations of the earth; and the heavens are the work of thy hands. They shall perish, but thou shalt endure: yea all of them shall wax old, as doth a garment; as a vesture shalt thou change them, and they shall be changed; but thou art the same, and thy years shall not fail.'

" The Koran, therefore, upon a retrospective view of these several circumstances, far from supporting its arrogant claim to a supernatural work, sinks below the level of many compositions confessedly of human original; and still lower does it fall in our estimation, when compared with that pure and perfect pattern which we justly admire in the Scriptures of truth.

" It is therefore abundantly apparent, that no miracle either was externally performed for the support, or is internally involved in the composition, of the Mahometan revelation."

Alcoran, is also figuratively applied to certain other books full of impieties and impostures. In this sense we meet with the Alcoran of the Cordeliers, which has made a great noise; wherein St Francis is extravagantly magnified, and put on a level with Jesus Christ. The Alcoran of the Cordeliers is properly an extract of a very scarce book, entitled, The Conformity of the Life of the seraphic father St Francis with the Life of Christ, published in 1510, 4to; since, at Bologna, in folio. Erasmus Albertus, being by the elector of Brandenburg appointed to visit a monastery of Franciscans,

Franciscans, found this book; and being struck with the extreme folly and absurdity of it, collected a number of curiosities out of it, and published them under the title of the *Alcoran* of the Franciscans, with a preface by Martin Luther.

ALCORANISTS, among *Mahometans*, those who adhere strictly to the letter or text of the Alcoran, from an opinion of its ultimate sufficiency and perfection. The Persians are generally *Alcoranists*, as admitting the Alcoran alone for their rule of faith. The Turks, Tartars, Arabs, &c. besides the Alcoran, admit a multitude of traditions. The Alcoranists, among Mahometans, amount to much the same with the Textuaries among the Jews. The Alcoranists can find nothing excellent out of the Alcoran; are enemies of philosophers, metaphysicians, and scholastic writers. With them the Alcoran is every thing.

ALCOVE, in *Architecture*, a recess, or part of a chamber separated by an estrade, or partition of columns, and other corresponding ornaments, in which is placed a bed of state, and sometimes seats to entertain company. These alcoves are frequent in Spain; and the bed is raised two or three ascents, with a rail at the foot.

ALCUINUS, Flaccus, an ecclesiastic of the eighth century. He was born, it is supposed, in Yorkshire. He was educated, however, at York, under the direction of Archbishop Egbert, as we learn from his own letters, in which he frequently calls that great prelate his beloved master, and the clergy of York the companions of his youthful studies. As he survived Venerable Bede about 70 years, it is hardly possible that he could have received any part of his education under him, as some writers of literary history have affirmed; and it is worthy of observation, that he never calls that great man his master, though he speaks of him with the highest veneration. It is not well known to what preferments he had attained in the church before he left England, though some say he was abbot of Canterbury. The occasion of his leaving his native country, was his being sent on an embassy by Offa king of Mercia to the emperor Charlemagne; who contracted so great an esteem and friendship for him, that he earnestly solicited, and at length prevailed upon him, to settle in his court, and become his preceptor in the sciences. Alcuinus accordingly instructed that great prince in rhetoric, logic, mathematics, and divinity; which rendered him one of his greatest favourites. "He was treated with so much kindness and familiarity (says a cotemporary writer) by the emperor, that the other courtiers called him, by way of eminence, *the emperor's delight*." Charlemagne employed his learned favourite to write several books against the heretical opinions of Felix bishop of Urgel, in Catalonia, and to defend the orthodox faith against that heresiarch, in the council of Francfort, A. D. 894; which he performed to the entire satisfaction of the emperor and council, and even to the conviction of Felix and his followers, who abandoned their errors. The emperor consulted chiefly with Alcuinus on all things relating to religion and learning; and by his advice, did many great things for the advancement of both. An academy was established in the imperial palace, over which Alcuinus presided, and in which the princes and prime nobility were educated; and other academies were established in the chief towns of Italy and France, at his instigation, and under his inspection. "France (says one of our best writers of literary history) is indebted to Alcuinus for all the polite learning it boasted of in that and the following ages. The universities of Paris, Tours, Fulden, Soissons, and many others, owe to him their origin and increase; those of whom he was not the superior and founder, being at least enlightened by his doctrine and example, and enriched by the benefits he procured for them from Charlemagne." After Alcuinus had spent many years in the most intimate familiarity with the greatest prince of his age, he at length, with great difficulty, obtained leave to retire from court to his abbey of St Martin's at Tours. Here he kept up a constant correspondence by letters with Charlemagne; from which it appears, that both the emperor and his learned friend were animated with the most ardent love to learning and religion, and constantly employed in contriving and executing the noblest designs for their advancement. He composed many treatises on a great variety of subjects, in a style much superior in purity and elegance to that of the generality of writers in the age in which he flourished. Charlemagne often solicited him, with all the warmth of a most affectionate friend, to return to court, and favour him with his company and advice; but he still excused himself; and nothing could draw him from his retirement in his abbey of St Martin in Tours, where he died A. D. 804. His works were collected and published by Andrew du Chesne in one volume folio, Paris, 1617. They consist of, 1. Tracts upon Scripture. 2. Tracts upon doctrine, discipline, and morality. 3. Historical treatises, letters, and poems. Since that edition, there has been published an incredible number of tracts, poems, &c. ascribed to this author, most of which, in all probability, were not his.

ALCYON, the trivial name of a species of alcedo. See Alcedo, Ornithology *Index*.

ALCYONIUM, an obsolete name of a submarine plant. It is also used for a kind of coral, or astroites, frequently found fossil in England.

Alcyonium Stagnum, in *Ancient Geography*, a lake in the territory of Corinth, whose depth was unfathomable, and in vain attempted to be discovered by Nero. Through this lake Bacchus is said to have descended to hell, to bring back Semele; (Pausanias).

ALCYONIUS, Peter, a learned Italian, who flourished in the 16th century. He was well versed in the Greek and Latin tongues, and wrote some pieces of eloquence which met with great approbation. He was corrector of the press a considerable time for Aldus Manutius, and is entitled to a share in the praises given to the editions of that learned printer. He published a treatise concerning banishment, which contained so many fine passages intermixed with others quite the reverse, that it was thought he had tacked to somewhat of his own, several fragments of a treatise of *Cicero de Gloria;* and that afterwards, in order to save himself from being detected in this theft, he burnt the manuscript of Cicero, the only one extant. Paulus Manutius, in his commentary upon these words of Cicero, *Librum tibi celeriter mittam de gloria*, "I will speedily send you my treatise on Glory;" has the following passage relating to this affair: "He means (says

(says he) his two books on Glory, which were handed down to the age of our fathers; for Bernard Justinian, in the index of his books, mentions *Cicero de Gloria*. This treatise, however, when Bernard had left his whole library to a nunnery, could not be found, though sought after with great care: nobody doubted but Peter Alcyonius, who, being physician to the nunnery, was entrusted with the library, had basely stolen it. And truly, in his treatise Of Banishment, some things are found interspersed here and there, which seem not to savour of Alcyonius, but of some higher author." The two orations he made after the taking of Rome, wherein he represented very strongly the injustice of Charles V. and the barbarity of his soldiers, were excellent pieces. There is also an oration ascribed to him, on the knights who died at the siege of Rhodes.

ALDBOROUGH, a sea-port town of England in Suffolk. It is pleasantly situated, in a dale, between a high hill to the westward, on which its large old-built church stands; the sea to the east, and its river running south-west. It is a large, long, ordinary town, made up of two or three streets of low houses, running parallel to each other. A quarter of a mile to the south lies Slaughden, where they have a commodious key, with warehouses for fish: more southerly still, they have conveniences for drying their north-sea fish. Their employment in the fishery is their chief business, which is considerable in the seasons for catching herrings and sprats; and it is the only place in England for curing red sprats. It is a town corporate, and sends two members to parliament. Towards the sea, it has some pieces of cannon planted for its defence. It is 88 miles north-east from London. E. Long. 1. 32. N. Lat. 52. 50.

Aldborough, a market-town in the west riding of Yorkshire, seated on the river Ouse, 15 miles north-west of York, and 200 miles north of London. It sends two members to parliament. W. Long. 0. 20. N. Lat. 54. 15. It was anciently a Roman city, called *Isurium Brigantum*; and several coins and monuments of the Saxons and Romans have been discovered there.

ALDEBARAN, in *Astronomy*, a star of the first magnitude, called in English the *bull's eye*, as making the eye of the constellation Taurus. Its longitude is 6 deg. 32 min. 9 sec. of Gemini, and its latitude 5 deg. 29 min. 40 sec. south.

ALDER-tree. See Betula, Botany *Index*.

ALDERHOLM, an island of Sweden, formed by the three arms of a river running through Gentle, a town of Nordland, in Sweden, 80 miles north from Stockholm. Here is a wharf, a repository for planks and deals, two packing houses, a large customhouse for taking toll of the ships, an arsenal for cannon, and a granary.

ALDERMAN, in the British policy, a magistrate subordinate to the lord-mayor of a city or town-corporate. The number of these magistrates is not limited, but is more or less according to the magnitude of the place. In London there are 26; each having one of the wards of the city committed to his care. This office is for life; so that when one of them dies, or resigns, a ward mote is called, who return two persons, one of whom the lord-mayor and aldermen choose to supply the vacancy. All the aldermen are justices of the peace, by a charter of 15 Geo. II. The aldermen of London, &c. are exempted from serving inferior offices; nor shall they be put upon assizes, or serve on juries, so long as they continue to be aldermen.

Alderman, among our Saxon ancestors, was a degree of nobility answering to earl or count at present.

Alderman was also used, in the time of King Edgar, for a judge or justice. Thus we meet with the titles of *aldermannus totius Angliæ, aldermannus regis, comitatus, civitatis, burgi, castelli, hundredi sive wapentachii, et novemdecimorum*. According to Spelman, the *aldermannus totius Angliæ* seems to have been the same officer who was afterwards styled *capitalis justiciarius Angliæ*, or chief-justice of England; the *aldermannus regis* seems to have been an occasional magistrate, answering to our justice of assize; and the *aldermannus comitatus*, a magistrate who held a middle rank between what was afterward called the *earl* and the *sheriff;* he sat at the trial of causes with the bishop: the latter proceeding according to ecclesiastical law, and the former declaring and expounding the common law of the land.

ALDERNEY, an island in the British channel, subject to the crown of Great Britain. It is about eight miles in compass, and is separated from Cape la Hogue, in Normandy, by a narrow strait, called the *Race of Alderney*, which is a very dangerous passage in stormy weather when the two currents meet; otherwise it is safe, and has depth of water for the largest ships. Through this strait the French fleet made their escape after their defeat at La Hogue, in 1692. It is a healthy island, has but one church, is fruitful both in corn and pasture, and is remarkable for a fine breed of cows. The inhabitants, for their greater safety, live together in a town of the same name. The number of houses is said to be 200, and the inhabitants 1000. It has but one harbour, called *Crabby*, which is at a good distance from the town; and is only fit for small vessels. To the west lie the range of rocks called the *Caskets*, so dangerous to mariners. W. Long. 2. 17. N. Lat. 49. 50.

ALDHELM, or Adelm, St, bishop of Shireburn in the time of the Saxon Heptarchy. He is said to have been the son of Kenred, brother to Ina, king of the West-Saxons; but, in the opinion of William of Malmsbury, his father was no more than a distant relation to the king. Having received the first part of his education in the school which one Macdulf, a learned Scot, had set up in the place where Malmsbury now stands, he travelled into France and Italy for his improvement. At his return home, he studied some time under Adrian abbot of St Augustine's in Canterbury, the most learned professor of the sciences who had ever been in England. In these different seminaries he acquired a very uncommon stock of knowledge; and became famous for his learning, not only in England, but in foreign countries: whence several learned men sent him their writings for his perusal and correction; particularly Prince Arcivil, a son of the king of Scotland, who wrote many pieces which he sent to Aldhelm, "entreating him to give them the last polish, by rubbing off their Scots rust." He was the first Englishman who wrote in the Latin language both in prose and verse, and composed a book for the instruction of his countrymen in the prosody of that language. Besides

Aldhelm ‖ Aldred.

fides this, he wrote feveral other treatifes on various fubjects; fome of which are loft, and others publifhed by Martin Delrio and Canifius. Venerable Bede, who flourifhed in the end of this and the beginning of the next century, gives the following character of Aldhelm: "He was a man of univerfal erudition, having an elegant ftyle, and being wonderfully well acquainted with books, both on philofophical and religious fubjects." In fact, confidering the cloud of ignorance by which he was furrounded, and the great difficulty of acquiring knowledge without proper inftruction, Aldhelm was a very extraordinary man. From one of his letters to Hedda bifhop of Winchefter, concerning the nature of his ftudies whilft at Canterbury, he appears to have been indefatigably determined to acquire every fpecies of learning in his power. For a copy of this curious epiftle, fee Henry's Hiftory, vol. ii. p. 320. King Alfred the Great declared, that Aldhelm was the beft of all the Saxon poets; and that a favourite fong, which was univerfally fung in his time, near 200 years after its author's death, was of his compofition, When he was abbot of Malmfbury, having a fine voice, and great fkill in mufic as well as poetry, and obferving the backwardnefs of his barbarous countrymen to liften to grave inftructions, he compofed a number of little poems, which he fung to them after mafs in the fweeteft manner; by which they were gradually inftructed and civilized. After this excellent perfon had governed the monaftery of Malmfbury, of which he was the founder, about 30 years, he was made bifhop of Shireburn, where he died A. D. 709.—He wrote, 1. *De octo vitiis principalibus*. This treatife is extant in *Bibliotheca Patrum* of Canifius. 2. *Ænigmatum verfus mille*. This, with feveral other of his poems, was publifhed by Martin Delrio at Mentz, 8vo, 1601. 3. A book addreffed to a certain king of Northumberland, named Alfrid, on various fubjects. 4. *De vita monachorum*. 5. *De laude fanctorum*. 6. *De arithmetica*. 7. *De aftrologia*. 8. A book againft the miftake of the Britons concerning the celebration of Eafter; printed by Sonius, 1576. 9. *De laude virginitatis*; manufcript, in Bennet-college, Cambridge; publifhed among Bede's *Opufcula*. Befides many fonnets, epiftles, and homilies in the Saxon language.

ALDPORT, an ancient name for Manchefter. See Manchester.

ALDRED, abbot of Taviftock, was promoted to the bifhopric of Worcefter in the year 1046. He was fo much in favour with King Edward the Confeffor, and had fo much power over his mind, that he obliged him to be reconciled with the worft of his enemies, particularly with Sweyn fon of the earl Goodwin, who had revolted againft him, and came with an army to invade the kingdom. Aldred alfo reftored the union and friendfhip between King Edward and Griffith king of Wales. He took afterwards a journey to Rome, and being returned into England, in the year 1054, he was fent ambaffador to the emperor Henry II. He ftaid a whole year in Germany, and was very honourably entertained by Herman archbifhop of Cologne, from whom he learned many things relating to ecclefiaftical difcipline, which on his return he eftablifhed in his own diocefe. In the year 1058 he went to Jerufalem, which no archbifhop or bifhop of England had ever done before him. Two years after he returned to England; and Kinfius archbifhop of York dying the 22d of December 1060, Aldred was elected in his ftead on Chriftmas day following, and was permitted to retain the fee of Worcefter with the archbifhopric of York, as fome of his predeceffors had done. Aldred went foon after to Rome, in order to receive the pall from the pope: He was attended by Tofton earl of Northumberland, Gifo bifhop of Wells, and Walter bifhop of Hereford. The pope received Tofton very honourably, and made him fit by him in the fynod which he held againft the fimonifts. He granted to Gifo and Walter their requeft, becaufe they were tolerably well learned, and not accufed of fimony. But Aldred being by his anfwers found ignorant, and guilty of fimony, the pope deprived him very feverely of all his honours and dignities; fo that he was obliged to return without the pall. On the way home he and his three fellow-travellers were attacked by fome robbers, who took from them all that they had, though they did not offer to kill them. This obliged them to return to Rome; and the pope, either out of compaffion, or by the threatenings of the earl of Northumberland, gave Aldred the pallium; but he was obliged to refign his bifhopric of Worcefter. However, as the archbifhopric of York had been almoft entirely ruined by the many invafions of foreigners, King Edward gave the new archbifhop leave to keep 12 villages or manors which belonged to the bifhopric of Worcefter. Edward the Confeffor dying in 1066, Aldred crowned Harold his fucceffor. He alfo crowned William the Conqueror, after he had made him take the following oath, viz. that he would protect the holy churches of God and their leaders; that he would eftablifh and obferve righteous laws; that he would entirely prohibit and fupprefs all rapines and unjuft judgements. He was fo much in favour with the Conqueror, that this prince looked upon him as a father; and, though imperious in regard to every body elfe, he yet fubmitted to obey this archbifhop: John Brompton gives us an inftance of the king's fubmiffion, which at the fame time fhows the prelate's haughtinefs.—It happened one day, as the archbifhop was at York, that the deputy-governor or lord-lieutenant going out of the city with a great number of people, met the archbifhop's fervants, who came to town with feveral carts and horfes loaded with provifions. The governor afked them to whom they belonged; and they having anfwered they were Aldred's fervants, the governor ordered that all thefe provifions fhould be carried to the king's ftorehoufe. The archbifhop fent immediately fome of his clergy to the governor, commanding him to deliver the provifions, and to make fatisfaction to St Peter, and to him the faint's vicar, for the injury he had done them; adding, that if he refufed to comply, the archbifhop would make ufe of his apoftolic authority againft him, (intimating thereby that he would excommunicate him). The governor, offended at this proud meffage, ufed the perfons whom the archbifhop had fent him very ill, and returned an anfwer as haughty as the meffage was. Aldred thereupon went to London to make his complaint to the king; but in this very complaint he acted with his wonted infolence; for meeting the king in the church of St Peter at Weftminfter, he fpoke to him in thefe words: "Hearken, O William: when thou waft but a foreigner, and God, Aldred, Aldrich.

God, to punish the sins of this nation, permitted thee to become master of it, after having shed a great deal of blood, I consecrated thee, and put the crown upon thy head with blessings; but now, because thou hast deserved it, I pronounce a curse over thee, instead of a blessing, since thou art become the persecutor of God's church, and of his ministers, and hast broken the promises and the oaths which thou madest to me before St Peter's altar." The king, terrified at this discourse, fell upon his knees, and humbly begged the prelate to tell him, by what crime he had deserved so severe a sentence. The noblemen, who were present, were enraged against the archbishop, and loudly cried out he deserved death, or at least banishment, for having offered such an injury to his sovereign; and they pressed him with threatenings to raise the king from the ground. But the prelate, unmoved at all this, answered calmly, "Good men, let him lie there, for he is not at Aldred's but at St Peter's feet; he must feel St Peter's power, since he dared to injure his vicegerent." Having thus reproved the nobles by his episcopal authority, he vouchsafed to take the king by the hand, and to tell him the ground of his complaint. The king humbly excused himself, by saying he had been ignorant of the whole matter; and begged of the noblemen to entreat the prelate, that he might take off the curse he had pronounced, and to change it into a blessing. Aldred was at last prevailed upon to favour the king thus far; but not without the promise of several presents and favours, and only after the king had granted him to take such a revenge on the governor as he thought fit. Since that time (adds the historian) none of the noblemen ever dared to offer the least injury. It may be questioned, which was more surprising here, whether the archbishop's haughtiness, who dared to treat his sovereign after so unbecoming a manner; or the king's stupidity, who suffered such insolence and audaciousness from a priest?—The Danes having made an invasion in the north of England in the year 1668, under the conduct of Harold and Canute the sons of King Sweyn, Aldred was so much afflicted at it, that he died of grief the 11th of September in that same year, having besought God that he might not see the desolation of his church and country.

ALDRICH, Robert, bishop of Carlisle, was born at Burnham in Buckinghamshire about the year 1493, and educated at Eaton school; from whence, in 1507, he was elected scholar of King's college, Cambridge, where he took his degree in arts, and was afterwards proctor of the university. In 1525, he was appointed master of Eaton school, then became fellow of that college, and finally provost. In 1529, he went to Oxford, where, being first incorporated bachelor of divinity, in the following year he proceeded doctor in that faculty: in 1531, he was made archdeacon of Colchester; in 1534, canon of Windsor; and the same year, registrary of the order of the garter. He was consecrated bishop of Carlisle in the year 1537, and died at Horncastle in Lincolnshire in 1556. He wrote, 1. *Epistola ad Gul. Hormanum*, in Latin verse; printed in Horman's *Antibossican*, Lond. 1521, of which book Pitts erroneously makes Aldrich the author. 2. *Epigrammata varia*. 3. *Latin verses, and another epistle to Horman*, prefixed to the *Vulgaria puerorum* of that author, Lond. 1519, 4to. 4. *Answers to certain queries concerning the abuses of the mass*; also *about receiving the sacrament*.

Aldrich.

Aldrich, *Dr Henry*, an eminent English divine and philosopher, born at London in 1647, was educated at Westminster school under the famous Dr Busby, and admitted of Christ-church college, Oxford. He had a great share in the controversy with the Papists in the reign of James II. and Bishop Burnet ranks him among those who examined all the points of Popery with a solidity of judgment, clearness of argument, depth of learning, and vivacity of writing, far beyond any who had before that time written in our language. He rendered himself so conspicuous, that at the Revolution, when Massey the Popish dean of Christ-church fled, his deanery was conferred on him. In this station he behaved in an exemplary manner, and that fabric owes much of its beauty to his ingenuity: it was Aldrich who designed the beautiful square called *Peckwater-Quadrangle*, which is esteemed an excellent piece of architecture. In imitation of his predecessor Dr Fell, he published, yearly, a piece of some ancient Greek author, as a present to the students of his house. He published *A System of Logic*, with some other pieces: and the revising Clarendon's History of the Rebellion was intrusted to him and Bishop Spratt; but it doth not appear that they made any additions, or considerable alterations in it, as has been asserted by Mr Oldmixon. Besides his preferments above mentioned, Dr Aldrich was also rector of Wem in Shropshire. He was chosen prolocutor of the convocation in 1702. This worthy person died at Christ-church on the 14th of December 1710. As to his character, he was a most universal scholar, and had a taste for all sorts of learning, especially architecture. Sir John Hawkins has favoured the public with several particulars relative to Dr Aldrich's skill in music; and on account of the Doctor's eminence in this respect, Sir John hath given his life, with his head prefixed. His abilities as a musician rank him, we are told, among the greatest masters of the science. He composed many services for the church, which are well known; as are also his anthems, nearly to the number of 20. He adapted, with great skill and judgment, English words to many of the notes of Palestrina, Carissimi, Victoria, and other Italian composers for the church, some of which are frequently sung in our cathedrals as anthems. By the happy talent which Dr Aldrich possessed, of naturalizing the compositions of the old Italian masters, and accommodating them to an English ear, he increased the stores of our own church. Though the Doctor chiefly applied himself to the cultivation of sacred music, yet, being a man of humour, he could divert himself by producing pieces of a lighter kind. There are two catches of his; the one, "Hark the bonny Christ-church Bells;" the other entitled, "A Smoking Catch," to be sung by four men smoking their pipes, which is not more difficult to sing than diverting to hear. His love of smoking was, it seems, so excessive as to be an entertaining topic of discourse in the university. Such was Dr Aldrich's regard for the advancement of music, and the honour of its professors, that he had formed a design of writing a history of the science; and the materials from which he proposed to compile it are yet extant in the library of his own college. It appears from these materials, that he had marked

marked down every thing which he had met with concerning music and musicians; but that he had brought no part of them into any kind of form.

Dr Aldrich is of some note as a Latin poet. In the *Musæ Anglicanæ*, we find two elegant copies of verses by him; one on the accession of King William III. and the other on the death of the duke of Gloucester. Sir John Hawkins has preserved a humorous translation by him of the well-known English ballad,

> " A soldier and a sailor,
> " A tinker and a tailor," &c.

The following epigram, entitled " Causæ Bibendi," is likewise ascribed to Dr Aldrich:

> " *Si bene quid memini, Causæ sunt quinque bibendi,*
> " *Hospitis Adventus; præsens Sitis,* atque *futura;*
> " *Aut Vini Bonitas; aut quæ libet altera Causa.*"

The epigram has been thus translated:

> " If on my theme I rightly think,
> " There are five reasons why men drink:
> " Good wine, a friend, because I'm dry,
> " Or least I should be and bye,
> " Or any other reason why."

The translation is not equal to the original. It is evident, from the verses cited and referred to, that Dr Aldrich was of a very cheerful and pleasant turn of mind. Indeed, he is always spoken of as having been a man of wit; and as one who, to his great talents and virtues, joined those amiable qualities which rendered him the object of general affection, as well as of general esteem and respect. Having never been married, he appropriated his income to works of hospitality and beneficence, and in encouraging learning to the utmost of his power, of which he was a most munificent patron, as well as one of the greatest men in England, if considered as a Christian or a gentleman. He had always the interest of his college at heart, whereof he was an excellent governor. His modesty and humility prevented him from prefixing his name to the learned tracts which he published during his life. At his death he wished to be buried in the cathedral without any memorial; which his thrifty nephew complied with, depositing him on the south side of Bishop Fell's grave, December 22. eight days after his decease; which happened in the 63d or 64th year of his age.

ALDROVANDA. See Botany *Index*.

ALDROVANDUS, Ulysses, professor of philosophy and physic at Bologna, the place of his nativity. He was a most curious inquirer into natural history, and travelled into the most distant countries on purpose to inform himself of their natural productions. Minerals, metals, plants, and animals, were the objects of his curious researches; but he applied himself chiefly to birds, and was at great expence to have figures of them drawn from the life. Aubert le Mire says, that he gave a certain painter, famous in that art, a yearly salary of 200 crowns, for 30 years and upwards; and that he employed at his own expence Lorenzo Bennini and Cornelius Swintus, as well as the famous engraver Christopher Coriolanus. These expences ruined his fortune, and at length reduced him to the utmost necessity; and it is said that he died blind in an hospital at Bologna, at a great age, in 1605. Mr Bayle observes, that antiquity does not furnish us with an instance of a design so extensive and so laborious as that of Aldrovandus, with regard to natural history; that Pliny has treated of more kinds of subjects, but only touches lightly on them, saying but a little upon any thing, whereas Aldrovandus has collected all he could meet with. His compilation, or that compiled upon his plan, consists of 13 volumes in folio, several of which were printed after his death. He himself published his Ornithology, or History of Birds, in three folio volumes, in 1599; and his seven books of insects, which make another volume of the same size. The volume Of Serpents, three Of Quadrupeds, one Of Fishes, that Of exanguious Animals, the History of Monsters, with the Supplement to that of Animals, the treatise Of Metals, and the Dendrology or History of Trees, were published at several times after the death of Aldrovandus, by the care of different persons; and Aldrovandus is the sole author only of the first six volumes of this work, the rest having been finished and compiled by others, upon the plan of Aldrovandus: a most extensive plan, wherein he not only relates what he has read in naturalists, but remarks also what historians have written, legislators ordained, and poets feigned: he explains also the different uses which may be made of the things he treats of, in common life, in medicine, architecture, and other arts; in short, he speaks of morality, proverbs, devices, riddles, hieroglyphics, and many other things which relate to his subject.

ALDUABIS, in *Ancient Geography*, a river of Celtic Gaul, which rising from Mount Jura, separating the Sequani from the Helvetii, and running through the county of Burgundy, or the Franche Comté, environs almost on every side the city of Besançon; and running by Dole, falls into the Saone near Chalons. By Cæsar it is called *Alduasdubis;* in Ptolemy, *Dubis:* now *le Doux*.

ALE, a fermented liquor obtained from an infusion of malt, and differing from beer chiefly in having a less proportion of hops. (See Brewing.) This liquor, the natural substitute of wine in such countries as could not produce the grape, was originally made in Egypt, the first planted kingdom, on the dispersion from the east, that was supposed unable to produce grapes. And, as the Noachian colonies pierced further into the west, they found, or thought they found, the same defect, and supplied it in the same manner. Thus the natives of Spain, the inhabitants of France, and the aborigines of Britain, all used an infusion of barley for their ordinary liquor: and it was called by the various names of *Cælia* and *Ceria* in the first country, *Cerevisia* in the second, and *Curmi* in the last; all literally importing only *the strong water*.

" All the several nations (says Pliny) who inhabit the west of Europe, have a liquor with which they intoxicate themselves made of corn and water. The manner of making this liquor is somewhat different in Gaul, Spain, and other countries, and is called by many various names; but its nature and properties are everywhere the same. The people of Spain, in particular, brew this liquor so well, that it will keep good a long time. So exquisite is the cunning of mankind, in gratifying their vicious appetites, that they have thus invented a method to make water itself intoxicate."

cate." The method in which the ancient Britons, and other Celtic nations, made their ale, is thus deſcribed by Iſidorus and Oroſius. "The grain is ſteeped in water and made to germinate, by which its ſpirits are excited and ſet at liberty; it is then dried and grinded; after which it is infuſed in a certain quantity of water; which being fermented, becomes a pleaſant, warming, ſtrengthening, and intoxicating liquor." This ale was moſt commonly made of barley; but ſometimes of wheat, oats, and millet.

Anciently the Welch and Scots had alſo two kinds of ale, called *common ale* and *ſpiced ale;* and their value was thus aſcertained by law: "If a farmer hath no mead, he ſhall pay two caſks of ſpiced ale, or four caſks of common ale, for one caſk of mead." By this law, a caſk of ſpiced ale, nine palms in height, and 18 palms in diameter, was valued at a ſum of money equal in efficacy to 7l. 10s. of our preſent money; and a caſk of common ale, of the ſame dimenſions, at a ſum equal to 3l. 15s. This is a ſufficient proof, that even common ale in this period was an article of luxury among the Welch, which could only be obtained by the great and opulent. Wine ſeems to have been quite unknown even to the kings of Wales, in this period, as it is not ſo much as once mentioned in their laws; though Giraldus Cambrenſis, who flouriſhed about a century after the Conqueſt, acquaints us, that there was a vineyard in his time at Maenarper, near Pembroke, in South Wales.

Ale was the favourite liquor of the Anglo-Saxons and Danes, as it had been of their anceſtors the ancient Germans. Before their converſion to Chriſtianity, they believed that drinking large and frequent draughts of ale was one of the chief felicities which thoſe heroes enjoyed who were admitted into the hall of Odin.

There are various ſorts of ale known in Britain, particularly *pale* and *brown:* the former is brewed from malt ſlightly dried; and is eſteemed more viſcid than the latter, which is made from malt more highly dried or roaſted.

Pale ale brewed with hard waters, as thoſe of ſprings and wells, is judged the moſt wholeſome, in regard the mineral particles tend to prevent the coheſions of thoſe drawn from the grain, and enable them to paſs the proper ſecretions the better; ſofter waters, as thoſe of rivers, and rain, ſeem better ſuited to draw out the ſubſtance of high-dried malts, which retain many igneous particles, beſt abſorbed in a ſmooth vehicle.

In Staffordſhire, they have a ſecret of fining ale in a very ſhort time. Plot conjectures it to be done by adding alum, or vinegar, in the working.

Ale is prepared various ways, and of various ingredients, as of wheat, rye, millet, oats, barley, the berries of the quickbean, &c.

Some have found that the juice which bleeds from the birch or ſycamore is of great uſe on this occaſion, applied inſtead of water. It makes one buſhel of malt go as far as four in the common way.

Some have a method of preparing ale, ſo that it will keep, carried to the Eaſt or Weſt Indies. The ſecret is, by maſhing twice with freſh malt; boiling twice; and, after ſhipping it, putting to every five gallons two new-laid eggs whole, to remain therein. It is ſaid, that in a fortnight's time, the ſhells will be diſſolved; and the eggs become like wind-eggs; and that afterwards the white would diſappear and the yoke remain untouched.

The conſumption of ale in theſe kingdoms is incredible. It was computed twenty years ago at the value of four millions yearly, including Great Britain and Ireland.

The duties on ale and beer make a principal branch of the revenue in Britain. They were firſt impoſed by the 12th of Car. II. and have been continued by ſeveral ſubſequent acts of parliament to firſt Geo. III. which lays an additional duty of 3d. per barrel. In the whole, the brewer of ale and beer for ſale ſhall pay 8s. for every barrel of either, above 6s. a barrel; and for every barrel of 6s. or under, the ſum of 1s. 4d.

Medicated Ales, thoſe wherein medicinal herbs have been infuſed, or added during the fermentation.

Gill Ale, is that in which the dried leaves of gill or ground-ivy have been infuſed. It is eſteemed abſterſive and vulnerary, and conſequently good in diſorders of the breaſt and obſtructions of the viſcera.

Ale Conner, an officer in London, who inſpects the meaſures uſed in public houſes. There are four ale conners, who are all choſen by the liverymen in common hall on Midſummer day.

Alehouses muſt be licenſed by juſtices of the peace, who take recognizances of the perſons licenſed, and of their ſureties, viz. 10l. each, that they will not ſuffer unlawful gaming, nor other diſorderly practices in their houſes. Every perſon, excepting thoſe who ſell ale in fairs, neglecting to procure a licenſe, is liable to a penalty of 40s. for the firſt offence, 4l. for the ſecond, and 6l. for the third, with all coſts. The licenſe granted on the firſt of September, or within twenty days after, at a general meeting of the juſtices for the diviſion to which he belongs, upon his producing a certificate to his character, unleſs, by living in a city or town-corporate, this laſt circumſtance is diſpenſed with, and continues in force for one year only. Alehouſe-keepers, ſelling ale in ſhort meaſure, are liable to a penalty not exceeding 40s. and not leſs than 10s. and likewiſe to a fine of 10s. for permitting tippling, &c.

By 29th Geo. II. c. 12. perſons keeping alehouſes in Scotland ſhall be licenſed as in England, and the juſtices there ſhall meet annually to licenſe alehouſes; on each of which licenſes a fee of 1s. is payable to the clerk of the peace. Magiſtrates of royal boroughs ſhall meet yearly for the like purpoſe; but where there ſhall not be a ſufficient number of magiſtrates to act in any royal borough, juſtices may grant licenſes, to be in force for one year only. *Ibid.*

Perſons in Scotland convicted of keeping unlicenſed alehouſes ſhall forfeit for the firſt offence 5s. for the ſecond 10s. for the third 20s. and to be diſqualified; and for every ſubſequent offence 40s. to be levied by diſtreſs and ſale, one moiety to the informer, the other to the poor of the pariſh. Conviction to be intimated to the offender, and certified to the clerk of the peace, and recorded: but perſons aggrieved may appeal to the quarter-ſeſſions. *Ibid.*

Licenſes for houſes on the military roads in Scotland ſhall be iſſued on payment of 1s. only to the clerk of the peace: making out licenſes before the ſame be ſtamped, is a penalty of 10l. and making them contrary

trary to the intention of this act, 5l. and the same shall be vacated, unless the duty and fine be paid, and the receipt produced, and license stamped. *Ibid.*

Ale-Silver, a tax paid annually to the lord-mayor of London, by all who sell ale within the city.

ALEA, in *Roman Antiquity*, denotes in general all manner of games of chance; but, in a more restricted sense, was used for a particular game played with dice and tables, not unlike our backgammon.

ALEANDER, Jerome, cardinal and archbishop of Brindisi, was born in 1480; and distinguished himself at the beginning of the reformation, by the opposition he made to Luther: for being sent into Germany as the pope's nuncio in 1519, he acted, as occasion served, in the character both of ambassador and doctor; and declaimed three hours together against Luther's doctrine before the diet of Worms, but could not prevent that celebrated reformer from being heard in that diet. He published several works, and died at Rome in 1542.

Aleander, *Jerome*, nephew of the former, a learned man of the seventeenth century, born in the principality of Friuli, of the same family with the preceding. When he went to Rome, he was employed as secretary under Cardinal Octavius Bandini, and discharged this office with great honour for almost twenty years. He afterwards, by the persuasion of Urban VIII. who had a great esteem for him, became secretary to Cardinal Barberini, whom he accompanied to Rome when he went there in the character of legate *à latere*, and in whose service he died in 1631. He was one of the first members of the academy of Humorists, wrote a learned treatise in Italian on the device of the society, and displayed his genius on many different subjects. Barberini gave him a magnificent funeral at the academy of Humorists; the academists carried his corpse to the grave; and Gaspar Simeonibus, one of the members, made his funeral oration.

ALECTO, one of the Furies, daughter of Acheron and Night, or, as others would have it, of Pluto and Proserpine.

ALECTORIA, a stone said to be formed in the gall-bladders of old cocks, to which the ancients ascribed many fabulous virtues. This is otherwise called *Alectorius Lapis*, sometimes *Alectorolithos*, in English the *cock-stone*. The more modern naturalists hold the *alectorius lapis* to be originally swallowed down, not generated in, the stomach or gizzard of cocks and capons. It is known that many of the fowl kind make a practice of swallowing pebbles, as it is supposed to be of service in the business of trituration and digestion.

ALECTOROMANTIA, in *Antiquity*, a species of divination performed by means of a cock. This is otherwise called *Alectryomancy;* of which there appear to have been different species. But that most spoken of by authors was in the following manner: A circle was described on the ground, and divided into twenty-four equal portions; in each of these spaces was written one of the letters of the alphabet, and on each of the letters was laid a grain of wheat; after which, a cock being turned loose in the circle, particular notice was taken of the grains picked up by the cock, because the letters under them, being formed into a word, made the answer desired. It was thus, according to Zonaras, that Libanius and Jamblicus sought who should succeed the emperor Valens; and the cock eating the grains answering to the spaces ΘΕΟΔ, several whose names began with those letters, as Theodotus, Theodistes, Theodulus, &c. were put to death; which did not hinder, but promote, Theodosius to the succession. But the story, however current, is but ill supported: It has been called in question by some, and refuted by others, from the silence of Marcellinus, Socrates, and other historians of that time.

ALEE, in the sea language, a term only used when the wind, crossing or flanking the line of a ship's course, presses upon the masts and sails so as to make her incline to one side, which is called the lee-side: hence, when the helm is moved over to this side, it is said to be *alee*, or *hard-a-lee*.

ALEGAMBE, Philip, a celebrated Jesuit, born at Brussels in 1592, distinguished himself by publishing a Bibliotheque of the writers of his order, and died at Rome in 1652.

ALEGRETTE, a small town of Portugal, in Alentejo, on the confines of Port Alegre, on the river Caja, which falls into the Guadiana, a little below Bajadoz, near the frontiers of Spanish Estremadura. It is a very pretty town, and finely situated; seven miles south-east of Port Alegre, and thirty north of Elvas. W. Long. 5. 20. N. Lat. 39. 6.

ALEIUS CAMPUS, in *Ancient Geography*, a plain in Cilicia, on this side the river Pyramus, near the mountain Chimera, famous for Bellerophon's wandering and perishing there, after being thrown off Pegasus; which is the reason of the appellation.

ALEMANIA, or Allemania, in *Ancient Geography*, a name of Germany, but not known before the time of the Antonines, and then used only for a part. After the Marcomanni and their allies had removed from the Rhine, a rabble, or collection of people from all parts of Gaul, as the term *Alemanni* denotes, prompted either by levity or poverty, occupied the lands, called *Decumates* by Tacitus, because they held them on a tithe; now supposed to be the duchy of *Wirtemburg*. Such appear to have been the small beginnings of Alemania, which was in after-times greatly enlarged: but still it was considered as a distinct part; for Caracalla, who conquered the Alemanni, assumed the surname both of *Alemannicus* and *Germanicus*.

ALEMBDAR, an officer in the court of the Grand Signior, who bears the green standard of Mahomet, when the sultan appears in public on any solemn occasion.

ALEMBERT, John le Rond d', an eminent French philosopher, was born at Paris in 1717. He derived the name of John le Rond from that of the church near which, after his birth, he was exposed as a foundling. His father, informed of this circumstance, listened to the voice of nature and duty, took measures for the proper education of his child, and for his future subsistence in a state of ease and independence.

He received his first education in the College of the Four Nations, among the Jansenists, where he gave early marks of capacity and genius. In the first year of his philosophical studies, he composed a Commentary on the Epistle of St Paul to the Romans. The Jansenists considered this production as an omen that portended to the party of Port-Royal a restoration to

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Alembert. ſome part of their ancient ſplendour, and hoped to find one day in M. d'Alembert a ſecond Paſcal. To render this reſemblance more complete, they engaged their riſing pupil in the ſtudy of the mathematics: but they ſoon perceived that his growing attachment to this ſcience was likely to diſappoint the hopes they had formed with reſpect to his future deſtination: they therefore endeavoured to divert him from this line; but their endeavours were fruitleſs.

At his leaving college, he found himſelf alone and unconnected in the world; and ſought an aſylum in the houſe of his *nurſe*. He comforted himſelf with the hope, that his fortune, though not ample, would better the condition and ſubſiſtence of that family, which was the only one that he could conſider as his own: Here, therefore, he took up his reſidence, reſolving to apply himſelf entirely to the ſtudy of geometry: And here he lived, during the ſpace of forty years, with the greateſt ſimplicity, diſcovering the augmentation of his means only by increaſing diſplays of his beneficence, concealing his growing reputation and celebrity from theſe honeſt people, and making their plain and uncouth manners the ſubject of good-natured pleaſantry and philoſophical obſervation. His good nurſe perceived his ardent activity; heard him mentioned as the writer of many books; but never took it into her head that he was a great man, and rather beheld him with a kind of compaſſion. "*You will never*, ſaid ſhe to him one day, "*be any thing but a philoſopher—and what is a philoſopher?—a fool, who toils and plagues himſelf during his life, that people may talk of him when* HE IS NO MORE."

As M. d'Alembert's fortune did not far exceed the demands of neceſſity, his friends adviſed him to think of a profeſſion that might enable him to augment it. He accordingly turned his views to the law, and took his degrees in that line; but ſoon abandoned this plan, and applied to the ſtudy of medicine. Geometry, however, was always drawing him back to his former purſuits; and after many ineffectual efforts to reſiſt its attractions, he renounced all views of a lucrative profeſſion, and gave himſelf over entirely to mathematics and poverty.

In the year 1741 he was admitted member of the Academy of Sciences; for which diſtinguiſhed literary promotion, at ſuch an early age, he had prepared the way by correcting the errors of a celebrated work*, which was deemed *claſſical* in France in the line of geometry. He afterwards ſet himſelf to examine, with deep attention and aſſiduity, what muſt be the motion of a body which paſſes from one fluid into another more denſe, in a direction not perpendicular to the ſurface ſeparating the two fluids. Every one knows the phenomenon which happens in this caſe, and which amuſes children under the denomination of *Ducks and Drakes*; but M. d'Alembert was the firſt who explained it in a ſatisfactory and philoſophical manner.

* The *Analyſe demontrée* of F. Beniau.

Two years after his election to a place in the academy, he publiſhed his *Treatiſe on Dynamics*. The new principle developed in this treatiſe conſiſted in eſtabliſhing equality, at each inſtant, between the changes that the motion of a body has undergone, and the forces or powers which have been employed to produce them; or, to expreſs the thing otherwiſe, in ſeparating into *two parts* the action of the moving powers, and conſidering the *one* as producing alone the motion of the body in the ſecond inſtant, and the *other* as employed to deſtroy that which it had in the firſt. Alembert.

So early as the year 1744, M. d'Alembert had applied this principle to the theory of the equilibrium, and the motion of fluids; and all the problems before ſolved by geometricians became, in ſome meaſure, its corollaries. The diſcovery of this new principle was followed by that of a new calculus, the firſt trials of which were publiſhed in a *Diſcourſe on the general Theory of the Winds*, to which the prize-medal was adjudged by the academy of Berlin in the year 1746, and which was a new and brilliant addition to the fame of M. d'Alembert.

He availed himſelf of the favourable circumſtance of the king of Pruſſia having juſt terminated a glorious campaign by an honourable peace, and in alluſion to this dedicated his work to that prince in the three following Latin verſes:

Hæc ego de ventis, dum ventorum ocyor alis,
Palantes agit Auſtriacos Fredericus, et orbi,
Inſignis lauro, ramum prætendit olivæ.

Swifter than wind, while of the winds I write,
The foes of conquering Frederick ſpeed their flight,
While laurel o'er the hero's temple bends
To the tir'd world the olive branch he ſends.

This flattering dedication procured the philoſopher a polite letter from Frederick, and a place among his literary friends.

In the year 1747 d'Alembert applied his new calculus of "Partial Differences" to the problem of vibrating chords, whoſe ſolution, as well as the theory of the oſcillations of the air and the propagation of ſound, had been given but incompletely by the geometricians who preceded him, and theſe were his maſters or his rivals.

In the year 1749 he furniſhed a method of applying his principle to the motion of any body of a given figure; and he ſolved the problem of the preceſſion of the equinoxes, determined its *quantity*, and explained the phenomenon of the nutation of the terreſtrial axis diſcovered by Dr Bradley.

In 1752, M. d'Alembert publiſhed a treatiſe on the *Reſiſtance of Fluids*, to which he gave the modeſt title of an *Eſſay*; but which contains a multitude of original ideas and new obſervations. About the ſame time he publiſhed, in the Memoirs of the Academy of Berlin, *Reſearches concerning the Integral Calculus*, which is greatly indebted to him for the rapid progreſs it has made in the preſent century.

While the ſtudies of M. d'Alembert were confined to geometry, he was little known or celebrated in his native country. His connexions were limited to a ſmall ſociety of ſelect friends: he had never ſeen any man in high office except Meſſrs d'Argenſon. Satisfied with an income which furniſhed him with the neceſſaries of life, he did not aſpire after opulence or honours, nor had they been beſtowed upon him, as it is eaſier to confer them on thoſe who ſolicit them than to look out for men who deſerve them. His cheerful converſation, his ſmart and lively ſallies, a happy knack at telling a ſtory, a ſingular mixture of malice of ſpeech with goodneſs of heart, and of delicacy of of wit with ſimplicity of manners, rendered him a pleaſing and intereſting companion, and his company conſequently was much ſought after in the faſhionable circles. His reputation, at length, made its way to the throne, and rendered him the object of royal attention and beneficence. He received alſo a penſion from government, which he owed to the friendſhip of Count d'Argenſon.

The tranquillity of M. d'Alembert was abated when his fame grew more extenſive, and when it was known beyond the circle of his friends, that a fine and enlightened taſte for literature and philoſophy accompanied his mathematical genius. Our author's eulogiſt aſcribes to envy, detraction, and to other motives equally ungenerous, all the diſapprobation, oppoſition, and cenſure that M. d'Alembert met with on account of the publication of the famous Encyclopedical Dictionary of Arts and Sciences, in conjunction with Diderot. None ſurely will refuſe the well-deſerved tribute of applauſe to the eminent diſplays of genius, judgment, and true literary taſte, with which M. d'Alembert has enriched the great work now mentioned. Among others, the Preliminary Diſcourſe he has affixed to it, concerning the riſe, progreſs, connexions, and affinities of all the branches of human knowledge, is perhaps one of the firſt productions of which the philoſophy of the preſent age can boaſt, and will be regarded as a ſtriking ſpecimen of juſt arrangement and ſound criticiſm, and alſo as a model of accurate thinking and elegant writing.

Some time after this, d'Alembert publiſhed his Philoſophical, Hiſtorical, and Philological Miſcellanies. Theſe were followed by the Memoirs of Chriſtina queen of Sweden; in which M. d'Alembert ſhowed that he was acquainted with the natural rights of mankind, and was bold enough to aſſert them. His *Eſſay on the Intercourſe of Men of Letters with Perſons high in Rank and Office*, wounded the former to the quick, as it expoſed to the eyes of the public the ignominy of thoſe ſervile chains, which they feared to ſhake off, or were proud to wear. A lady of the court hearing one day the author accuſed of having exaggerated the deſpotiſm of the great, and the ſubmiſſion they require, anſwered ſlyly, *If he had conſulted me, I would have told him ſtill more of the matter.*

M. d'Alembert gave very elegant ſpecimens of his literary abilities in his tranſlations of ſome ſelect pieces of Tacitus. But theſe occupations did not divert him from his mathematical ſtudies: for about the ſame time he enriched the Encyclopédie with a multitude of excellent articles in that line, and compoſed his *Reſearches on ſeveral important Points of the Syſtem of the World*, in which he carried to a higher degree of perfection the ſolution of the problem of the perturbations of the planets, that had ſeveral years before been preſented to the Academy.

In 1759 he publiſhed his *Elements of Philoſophy*: a work extolled as remarkable for its preciſion and perſpicuity; in which, however, are ſome tenets relative both to metaphyſics and moral ſcience, that are far from being admiſſible.

The reſentment that was kindled (and the diſputes that followed it) by the article *Geneva*, inſerted in the Encyclopédie, are well known. M. d'Alembert did not leave this field of controverſy with flying colours. Voltaire was an auxiliary in the conteſt: but as, in point of candour and decency, he had no reputation to loſe; and as he weakened the blows of his enemies, by throwing both them and the ſpectators into fits of laughter, the iſſue of the war gave him little uneaſineſs. It fell more heavily on d'Alembert; and expoſed him, even at home, to much contradiction and oppoſition.

It was on this occaſion that the late king of Pruſſia offered him an honourable aſylum at his court, and the place of preſident of his academy; and was not offended at his refuſal of theſe diſtinctions, but cultivated an intimate friendſhip with him during the reſt of his life. He had refuſed, ſome time before this, a propoſal made by the empreſs of Ruſſia to intruſt him with the education of the grand duke;—a propoſal accompanied with all the flattering offers that could tempt a man ambitious of titles, or deſirous of making an ample fortune: but the objects of his ambition were tranquillity and ſtudy.

In the year 1765, he publiſhed his *Diſſertation on the Deſtruction of the Jeſuits*. This piece drew upon him a ſwarm of adverſaries, who confirmed the merit and credit of his work by their manner of attacking it.

Beſide the works already mentioned, he publiſhed nine volumes of memoirs and treatiſes, under the title of *Opuſcules*; in which he has ſolved a multitude of problems relative to aſtronomy, mathematics, and natural philoſophy; of which our panegyriſt gives a particular account, more eſpecially of thoſe which exhibit new ſubjects, or new methods of inveſtigation.

He publiſhed alſo *Elements of Muſic*; and rendered, at length, the ſyſtem of Rameau intelligible; but he did not think the mathematical theory of the ſonorous body ſufficient to account for the rules of that art. He was always fond of muſic; which, on the one hand, is connected with the moſt ſubtile and learned reſearches of rational mechanics; while, on the other, its power over the ſenſes and the ſoul exhibits to philoſophers phenomena no leſs ſingular, and ſtill more inexplicable.

In the year 1772, he was choſen ſecretary to the French academy. He formed, ſoon after this preferment, the deſign of writing the lives of all the deceaſed academicians from 1700 to 1772; and in the ſpace of three years he executed this deſign, by compoſing 70 eulogies.

M. d'Alembert died on the 29th of October 1783. There were many amiable lines of candour, modeſty, diſintereſtedneſs, and beneficence, in his moral character; which are deſcribed, with a diffuſive detail, in his *eloge*, by M. Condorcet, *Hiſt. de l'Acad. Royale des Sciences*, 1783.

ALEMBIC, a chemical veſſel uſually made of glaſs or copper, formerly uſed for diſtillation. The bottom part, which contained the ſubject for diſtillation, is called, from its ſhape, the *cucurbit*; the upper part, which receives and condenſes the ſteam, is called the *head*, the beak of which is fitted into the neck of a receiver. Retorts, and the common *worm-ſtill*, are now more generally employed.

ALEMBROTH, in the writings of the alchemiſts, a word uſed for a ſort of fixed alkaline ſalt, which had the power of the famous alkaheſt, in diſſolving bodies, opening the pores of moſt or all known ſubſtances, and thence,

thence, as well as by deſtroying ſulphurs, promoting the ſeparation of metals from their ores.—It is alſo uſed for a compound of corroſive mercury and ſal ammoniac.

ALENIO, Julius, a Jeſuit, born at Breſcia in the republic of Venice. He travelled into the eaſtern countries; and arrived at Macao in 1610, where he taught mathematics. From thence he went to the empire of China, where he continued to propagate the Chriſtian religion for thirty-ſix years. He was the firſt who planted the faith in the province of Xanſi, and he built ſeveral churches in the province of Fokien. He died in Auguſt 1649, leaving behind him ſeveral works in the Chineſe language.

ALENTEJO, a province of Portugal, between the rivers Tajo and Guadiana: the ſoil is very fertile, and the inhabitants laborious and induſtrious. The principal town is Evora.

ALENZON, a town of France, the capital of the department of Orne, in Lower Normandy. It is ſurrounded with good walls, and flanked with towers. The caſtle was formerly a place of great conſequence, and has held out long ſieges. It has but one pariſh-church, which has a bold and noble front. Among the nunneries, that of St Clair is moſt remarkable. It is ſeated on the river Sarte, in a vaſt open plain, which produces all ſorts of corn and fruit. Near it there are quarries of ſtone fit for building, wherein are found a ſort like Briſtol ſtones. The trade of Alenzon is in linen, lace, ſtuffs, and leather. It is 20 miles north of Mons, 63 ſouth-by-weſt of Rouen, and 88 ſouth-weſt of Paris. Long. 0. 10. N. Lat. 48. 25.

ALEPPO, or Halab, the capital of a pachalic, and of all Syria, and the ordinary reſidence of the pacha, is ſituated in the vaſt plain which extends from the Orontes to the Euphrates, and which towards the ſouth terminates in the deſert. It is built on eight hills or eminences, on the higheſt of which the caſtle is erected, and is ſuppoſed to be the ancient Beræa. This mount is of a conic form, and ſeems in a great meaſure to be raiſed with the earth thrown up out of a deep broad ditch which ſurrounds it. The ſuburbs to the north-north-eaſt are next in height to this, and thoſe to the weſt-ſouth-weſt are much lower than the parts adjacent, and than any other part of the city. The houſes are large and commodious, having terraces on their tops, and generally ſky-lights in form of a dome to let the light into the rooms, which from their loftineſs, the gilding on the window ſhutters, cupboard-doors, &c. have at firſt entrance a very grand and agreeable effect. They are all ſo equal in height, that there are ſeldom any ſteps to aſcend or deſcend in going from one houſe to another; while ſeveral large vaulted ſtreets increaſe the facility of communication, by affording a paſſage to every part of the city free from the embarraſſment of the open ſtreets. They are carefully paved; have gutters and a foot-pavement on each ſide; and the middle of the ſtreet is laid with brick, the ſmall end upwards, for the convenience of the horſes. There is alſo a cleanlineſs obſerved here unknown to the other cities of Turkey, and which is not attended with the trouble of our ſcavengers, there being aſs-drivers who go about the city and take up the rubbiſh and duſt, which each inhabitant is obliged to ſweep together; and though the heat of the climate renders this labour more eaſy, the ſame heat obliges them to greater cleanlineſs in order to preſerve the ſalubrity of the air.

The moſques in Aleppo are numerous, and ſome few of them magnificent. Before each of them is an area, with a fountain in the middle, deſigned for ablutions before prayers; and behind ſome of the larger there are little gardens. There are many large khans, or caravanſeras, conſiſting of a capacious ſquare, on all ſides of which are a number of rooms, built on a ground-floor, uſed occaſionally for chambers, warehouſes, or ſtables. Above ſtairs there is a colonnade or gallery on every ſide, in which are the doors of a number of ſmall rooms, wherein the merchants, as well ſtrangers as natives, tranſact moſt of their buſineſs.

The bazars or market-places are long covered narrow ſtreets, on each ſide of which are a great number of ſmall ſhops, juſt ſufficient to hold the tradeſman and his goods, the buyer being obliged to ſtand without. Each ſeparate branch of buſineſs has a particular bazar, which is locked up, as well as the ſtreets, an hour and a half after ſunſet: but the locks are of wood, though the doors are caſed with iron. The ſlaughter-houſes are in the ſuburbs, open to the fields. The tanners have a khan to work in near the river. To the ſouthward in the ſuburbs they burn lime; and a little beyond that there is a village where they make ropes and catgut. On the oppoſite ſide of the river, to the weſtward, there is a glaſs-houſe, where they make a coarſe white glaſs, in the winter only; for the greateſt part of this manufacture is brought from a village 35 miles weſtward.

The ſituation of Aleppo, beſide the advantage of a rich and fruitful ſoil, poſſeſſes alſo that of a ſtream of freſh water, which never becomes dry. This rivulet, which is about as large as that of the Gobelins at Paris, or the New River near London, riſes in the mountains of Aentab, and terminates ſix leagues below Aleppo, in a moraſs full of wild boars and pelicans. Near Aleppo, its banks, inſtead of the naked rocks which line them in the upper part of its courſe, are covered with a fertile earth, and laid out in gardens, or rather orchards, which in a hot country, and eſpecially in Turkey, cannot but be delightful. The city is in itſelf one of the moſt agreeable in Syria, and is perhaps the cleaneſt and beſt built of any in Turkey. On whatever ſide it is approached, its numerous minarets and domes preſent an agreeable proſpect to the eye, fatigued with the continued ſameneſs of the brown and parched plains. In the centre is an artificial mountain ſurrounded by a dry ditch, on which is a ruinous fortreſs. From hence we have a fine proſpect of the whole city, and to the north diſcover the ſnowy tops of the mountains of Bailan; and on the weſt, thoſe which ſeparate the Orontes from the ſea; while to the ſouth, and eaſt, the eye can diſcern as far as the Euphrates. In the time of Omar, this caſtle ſtopped the progreſs of the Arabs for ſeveral months, and was at laſt taken by treachery, but at preſent would not be able to reſiſt the feebleſt aſſault. Its ſlight wall, low, and without a buttreſs, is in ruins; its little old towers are in no better condition; and it has not four cannon fit for ſervice, not excepting a culverine nine feet long, taken from the Perſians at the ſiege of Baſſora. Three hundred and fifty Janizaries, who

Aleppo. ſhould form the garriſon, are buſy in their ſhops, and the aga ſcarcely finds room in it to lodge his retinue. It is remarkable that this aga is named immediately by the Porte, which, ever ſuſpicious, divides as much as poſſible the different offices. Within the walls of the caſtle is a well, which, by means of a ſubterraneous communication, derives its water from a ſpring a league and a quarter diſtant. In the environs of the city, we find a number of large ſquare ſtones, on the top of which is a turban of ſtone, which are ſo many tombs. There are many riſing grounds round it, which, in caſe of a ſiege, would greatly facilitate the approaches of the aſſailants. Such, among others, is that on which the houſe of the Derviches ſtands, and which commands the canal and the rivulet: Aleppo, therefore, cannot be eſteemed a place of importance in war, though it be the key of Syria to the north; but, conſidered as a commercial city, it has a different appearance. It is the emporium of Armenia and Diarbekar; ſends caravans to Bagdad and into Perſia; and communicates with the Perſian gulf and India, by Baſſora, with Egypt and Mecca by Damaſcus, and with Europe by Scanderoon (Alexandretta) and Latakia. Commerce is there principally carried on by barter. The chief commodities are raw or ſpun cottons, clumſy linens fabricated in the villages, ſilk ſtuffs manufactured in the city, copper, *bourres* (coarſe cloths) like thoſe of Rouen, goats hair brought from Natolia, the gall nuts of the Kourdeſtan, the merchandiſe of India, ſuch as ſhawls and muſlins, and piſtachio nuts of the growth of the neighbourhood. The articles ſupplied by Europe are the Languedoc cloths, cochineal, indigo, ſugar, and ſome other groceries. The coffee of America, though prohibited, is introduced, and ſerves to mix with that of Moka. The French have at Aleppo a conſul and ſeven counting-houſes; the Engliſh and the Venetians two, and the merchants of Leghorn and Holland one. The emperor appointed a conſul there in 1784, in the perſon of a rich Jew merchant, who ſhaved his beard to aſſume the uniform and the ſword. Ruſſia has alſo ſent one very lately. Aleppo is not exceeded in extent by any city in Turkey, except Conſtantinople and Cairo, and perhaps Smyrna. The number of inhabitants has been computed at 200,000; but in theſe calculations certainty is impoſſible. However, if we obſerve that this city is not larger than Nantes or Marſeilles, and that the houſes conſiſt only of one ſtory, we ſhall perhaps not think it probable they exceed 100,000. The people of this city, both Turks and Chriſtians, are with reaſon eſteemed the moſt civilized in all Turkey; and the European merchants nowhere enjoy ſo much liberty, or are treated with ſo much reſpect.

The air of Aleppo is very dry and piercing, but at the ſame time very ſalubrious for all who are not troubled with aſthmatic complaints. The city, however, and the environs, are ſubject to a ſingular endemial diſorder, which is called the ringworm or pimple of Aleppo: it is in fact a pimple which is at firſt inflammatory, and at length becomes an ulcer of the ſize of the nail. The uſual duration of this ulcer is one year; it commonly fixes on the face, and leaves a ſcar which disfigures almoſt all the inhabitants. It is alleged that every ſtranger who reſides there three months is attacked with it; experience has taught that the beſt mode of treatment is to make uſe of no remedy. No reaſon is aſſigned for this malady: but M. Volney ſuſpects it proceeds from the quality of the water, as it is likewiſe frequent in the neighbouring villages, in ſome parts of Diarbekar, and even in certain diſtricts near Damaſcus, where the ſoil and the water have the ſame appearances. Of the Chriſtian inhabitants the greater number are Greeks, next to them the Armenians, then the Syrians, and laſtly the Maronites; each of whom have a church in the city called *Judida;* in which quarter, and the parts adjacent, moſt of them reſide. The common language is the vulgar Arabic, but the Turks of condition uſe the Turkiſh. Moſt of the Armenians can ſpeak the Armenian, ſome few Syrians underſtand Syriac, and many of the Jews Hebrew; but ſcarce one of the Greeks underſtand a word of Greek. The people in general are of a middle ſtature, and tolerably well proportioned; but they ſeem neither vigorous nor active. Both ſexes are handſome when young: but the beard ſoon disfigures the men: and the women, as they come early to maturity, alſo fade very ſoon; females are generally married from 14 to 18 years of age, and many under 14. The people of rank here are polite and affable, making allowances for that ſuperiority which the Mahometan religion inſtructs its votaries to aſſume over all who hold a different faith. Their bread is generally of wheat flour made into thin cakes, but very ill prepared, and is generally eaten as ſoon as it comes out of the oven. The principal people have ſmall loaves of a finer flour, which are well fermented and baked. Beſides theſe, there is a variety of biſcuits, moſt of which are ſtrewed on the top with ſome kind of ſeeds. The Europeans have very good bread, baked and prepared in the French manner. All the inhabitants of both ſexes ſmoke tobacco to great exceſs; even the very ſervants have almoſt conſtantly a pipe in their mouths. Coaches or carriages are not uſed here; therefore perſons of quality ride on horſeback in the city, with a number of ſervants walking before them, according to their rank: ladies of the firſt diſtinction are even compelled to walk on foot in the city, or to any place at a moderate diſtance; in longer journeys they are carried by mules, in a kind of couch cloſe covered up. There are a number of public bagnios in this city, which are uſed by people of all ranks, except thoſe of the higheſt diſtinction, who commonly have baths and every other convenience in their own houſes. Aleppo is 70 miles eaſt of Scanderoon, on the ſea-coaſt, and 175 north-by-eaſt of Damaſcus. E. Long. 37. 40. N. Lat. 36. 12. Aleppo.

Aleppo, The Pachalic of, one of the five governments into which Syria is divided. It comprehends the country extending from the Euphrates to the Mediterranean, between two lines, one drawn from Scanderoon to Beer, along the mountains: the other from Beles to the ſea, by Mara and the bridge of Shoger. This ſpace principally conſiſts of two plains; that of Antioch to the weſt, and that of Aleppo to the eaſt: the north and the ſea-coaſt are occupied by conſiderably high mountains, known to the ancients by the names of Amanus and of Rhoſus. In general, the ſoil of this government is fat and loamy. The lofty and vigorous plants which ſhoot up everywhere after the winter rains prove its fertility, but its actual fruitfulneſs is but little. The greateſt part of the lands lie

4 E 2 waſte;

wafte; fcarcely can we trace any marks of cultivation in the environs of the towns and villages. Its principal produce confifts in wheat, barley, and cotton, which are found efpecially in the flat country. In the mountains, they rather choofe to cultivate the vine, mulberry, olive, and fig trees. The fides of the hills towards the fea-coaft are appropriated to tobacco, and the territory of Aleppo to piftachios. The pafturage is not to be reckoned, becaufe that is abandoned to the wandering hordes of the Turcomans and Curds.

In the greater part of the pachalics the pacha is, as his title imports, at once the viceroy and farmer-general of the country; but in that of Aleppo he does not poffefs the latter office. This the Porte has beftowed on a *mehaffel* or collector, who is immediately accountable for what he receives. His leafe is only for a year. The prefent rent of his farm is 800 purfes (above 40,000l.); but to this muft be added the price of the *babouches* (Turkifh flippers), or a prefent of three or four thoufand pounds, to purchafe the favour of the vizier, and men in office. For thefe two fums the farmer receives all the duties of the government; which are, firft, The produce of import and export duties on merchandife coming from Europe, India, and Conftantinople, and on that exported in exchange. Secondly, The taxes paid by the herds of cattle brought every year by the Turcomans and Curds from Armenia and Diarbekar, to be fold in Syria. Thirdly, The fifth of the falt-works of Djeboul. And laftly, The miri, or land-tax. Thefe united may produce about 60,000l.

The pacha, deprived of this lucrative branch of the adminiftration, receives a fixed allowance of about 8300l. This revenue has always been inadequate to the expences; for, befides the troops he is obliged to maintain, and the reparation of the highways and fortreffes, the expences of which he is obliged to defray, he is under the neceffity of making large prefents to the minifters, in order to keep his place; but the Porte adds to the account the contributions he may levy on the Curds and Turcomans, and his extortions from the villages and individuals; nor do the pachas come fhort of this calculation. Abdi Pacha, who governed 13 or 14 years ago, carried off, at the end of 15 months, upwards of 160,000l. by laying under contribution every trade, even the very cleaners of tobacco-pipes; and very lately another of the fame name has been obliged to fly for fimilar oppreffions. The former was rewarded by the divan with the command of an army againft the Ruffians; but if the latter has not enriched himfelf, he will be ftrangled as an extortioner. Such is the ordinary progrefs of affairs in Turkey!

In confequence of fuch wretched government, the greater part of the pachalics in the empire are impoverifhed and laid wafte. This is the cafe in particular with that of Aleppo. In the ancient *deftars*, or regifters of impofts, upwards of 3200 villages were reckoned; but at prefent the collector can fcarcely find 400. Such of our merchants as have refided there 20 years, have themfelves feen the greater part of the environs of Aleppo become depopulated. The traveller meets with nothing but houfes in ruins, cifterns rendered ufelefs, and fields abandoned. Thofe who cultivate them have fled into the towns, where the population is abforbed, but where at leaft the individual conceals himfelf among the crowd from the rapacious hand of defpotifm.

ALERIA, Alalia, or Alaria, in *Ancient Geography*, a town of Corfica, fituated near the middle of the eaft fide of the ifland, on an eminence, near the mouth of the river Rotanus mentioned by Ptolemy; built by the Phocæans (Diodorus Siculus). Afterwards Sylla led a colony thither. It is now in ruins, and called *Aleria Diftrutta*.

ALES, Alexander, a celebrated divine of the confeffion of Augfbourg, was born at Edinburgh the 23d of April 1500. He foon made a confiderable progrefs in fchool divinity, and entered the lifts very early againft Luther, this being then the great controverfy in fafhion, and the grand field wherein all authors, young and old, ufed to difplay their abilities. Soon after, he had a fhare in the difpute which Patrick Hamilton maintained againft the ecclefiaftics, in favour of the new faith he had imbibed at Marpurg. He endeavoured to bring him back to the Catholic religion; but this he could not effect, and even began himfelf to doubt about his own religion, being much affected by the difcourfe of this gentleman, and ftill more by the conftancy he fhowed at the ftake, where David Beaton, archbifhop of St Andrew's, caufed him to be burnt. Beginning thus to waver, he was himfelf perfecuted with fo much violence, that he was obliged to retire into Germany, where he became at length a perfect convert to the Proteftant religion. The change of religion which happened in England after the marriage of Henry VIII. with Anna Bullen, induced Ales to go to London in 1535. He was highly efteemed by Cranmer archbifhop of Canterbury, Latimer, and Thomas Cromwell, who were at that time in high favour with the king. Upon the fall of thefe favourites, he was obliged to return to Germany; where the elector of Brandenburgh appointed him profeffor of divinity at Frankfort upon the Oder, in 1540. But leaving this place upon fome difguft, he returned to Leipfic, where he was chofen profeffor of divinity, and died in March 1565. He wrote a Commentary on St John, on the Epiftles to Timothy, and on the Pfalms, &c.

ALESA, Alæsa, or Halesa, in *Ancient Geography*, a town of Sicily, on the Tufcan fea, built, according to Diodorus Siculus, by Archonides of Herbita, in the fecond year of the 94th Olympiad, or 403 years before Chrift; fituated on an eminence about a mile from the fea: now in ruins. It enjoyed immunity from taxes under the Romans (Diodorus, Cicero). The inhabitants were called *Halefini* (Cicero, Pliny); alfo *Alefini*, and *Alæfini*.

ALESHAM, a fmall neat town in Norfolk. It is 15 miles north of Norwich, and 121 north-eaft-by north of London. E. Long. 0. 30. N. Lat. 52. 53. The town confifts of about 400 houfes.

ALESIA, in *Ancient Geography*, called *Alexia* by Livy and others; a town of the Mandubii, a people of Celtic Gaul; fituated, according to Cæfar, on a very high hill, whofe foot was wafhed on two fides by two rivers. The town was of fuch antiquity, that Diodorus Siculus relates it was built by Hercules. It is fuppofed to be the city of *Alife*, in the duchy of Burgundy, not far from Dijon.

ALET, a town of France, in the department of the Aude,

Aude, and district of Limoux, at the foot of the Pyrenees. It is remarkable for its baths, and for the grains of gold and silver found in the stream which runs from the Pyrenean mountains, at the foot of which it stands. It is seated on the river Aude, 15 miles south of Carcassone, and 37 north-west of Narbonne. E. Long. 2. 5. N. Lat. 42. 59.

ALETRIS. See BOTANY *Index*.

ALETUM, or ALETA, in *Ancient Geography*, a town of Celtic Gaul, now extinct. From its ruins arose St Malo in Britanny, at the distance of a mile. Its ruins are called *Guich Aleth* in the British.

ALEURITES. See BOTANY *Index*.

ALEUROMANCY, the same with what was otherwise called *alphitomantia*, and *crithomanthia*, and means an ancient kind of divination performed by means of meal or flower.

ALEUTIAN, or ALEUTSKY ISLANDS, a group or chain of islands on the north-east side of Kamschatka, and near the continent of America, which are subject to Russia. Part of these islands were discovered by Behring in the year 1741, and the rest at different periods since that time. Captain Cook visited these islands in 1778, and directed his researches and observations to a survey of them and of the adjacent coasts of Asia and America. On the Aleutian islands and the neighbouring coast, the Russians have formed numerous establishments for the support of the fur-trade, which is one of the most advantageous commercial concerns to the Russian empire. Captain Billings, who was sent out by the late empress Catharine to make discoveries in the north-east sea, explored, in the summer 1790, the whole chain of these islands. They seem to be of volcanic origin; have no wood, but what floats from sea; and lie between the 51st and the 56th degrees N. Lat. and the 164th and the 197th degrees of E. Long.

ALEXANDER THE GREAT, king of Macedonia. His father Philip laid the plan of that extensive empire, which his son afterwards completed. Philip, having made himself master of Greece, began to cast his eyes upon Persia, with a view to retaliate upon that haughty empire the injuries of former times. It was the popular topic of the day. But this prince was cut off in the midst of his enterprise. Such, however, was the influence of Alexander in the assembly of the Grecian states, that he was created general of their combined forces in the room of his father. Having made every needful preparation, at the head of a veteran army he invaded Asia. The lieutenants of Darius, who was then king of Persia, opposed him at the river Granicus, where Alexander obtained a complete victory, after which he pursued his march through Asia. At Issus, near Scanderoon, he was met by Darius in person, at the head of a prodigious army. Here he obtained a second victory; and took the camp of Darius, together with his family, whom he treated with the utmost humanity. Contrary to all the maxims of war, instead of pursuing Darius, he made an excursion into Egypt; and, as far as appears, through no better motives than those of vanity. Here he was acknowledged to be the son of Jupiter Ammon. In the mean time Darius recruited his strength, and got together an army superior to what he brought into the plain of Issus.

Alexander having finished his Egyptian expedition, traversed Asia, and passed the Euphrates. At Arbela, a town in Assyria, he met Darius. Here a decisive battle was fought, which put all Persia into the hands of Alexander. His ambition not being satisfied with the conquest of that vast country, he projected an expedition into India. Here he met with great opposition from Porus, a gallant prince, whom in the end he reduced. Beyond the Ganges lay a country still unsubdued. He notified it to his army, that he proposed to pass the river. But these veterans, harassed with their fatigues, and seeing no end of their labour, mutinied, and refused to march further. The disappointed chief was therefore obliged to return. At Babylon he proposed to receive ambassadors, appoint governors, and settle his vast monarchy; but his excesses put an end to his life in the midst of his designs, and in the flower of his age.

The character of this hero is so familiar to every body, that it is almost needless labour to draw it. All the world knows, says Mr Bayle, that it was equally composed of very great virtues and very great vices. He had no mediocrity in any thing but his stature: in his other properties, whether good or bad, he was all extremes. His ambition rose even to madness. His father was not at all mistaken in supposing the bounds of Macedon too small for his son: for how could Macedon bound the ambition of a man, who reckoned the whole world too small a dominion? He wept at hearing the philosopher Anaxarchus say, that there was an infinite number of worlds: his tears were owing to his despair of conquering them all, since he had not yet been able to conquer one. Livy, in a short digression, has attempted to inquire into the events which might have happened, if Alexander, after the conquest of Asia, had brought his arms into Italy? Doubtless things might have taken a very different turn with him; and all the grand projects, which succeeded so well against an effeminate Persian monarch, might easily have miscarried if he had had to do with rough hardy Roman armies. And yet the vast aims of this mighty conqueror, if seen under another point of view, may appear to have been confined in a very narrow compass; since, as we are told, the utmost wish of that great heart, for which the whole earth was not big enough, was, after all, to be praised by the Athenians: for it is related, that the difficulties which he encountered in order to pass the Hydaspes, forced him to cry out, "O Athenians, could you believe to what dangers I expose myself for the sake of being celebrated by you?" But Bayle affirms, that this was quite consistent with the vast unbounded extent of his ambition, as he wanted to make all future time his own, and be an object of admiration to the latest posterity; yet did not expect this from the conquest of worlds, but from books. He was perfectly in the right, says Bayle; "for if Greece had not furnished him with good writers, he would long ago have been as much forgotten as the kings who reigned in Macedon before Amphitryon."

Alexander has been praised upon the score of continency, yet his life could not surely be quite regular in that respect. Indeed, the fire of his early youth appeared so cold towards women, that his mother suspected

Alexander.

pected him to be impotent; and, to ſatisfy herſelf in this point, did, with the conſent of Philip, procure a very handſome courtezan to lie with him, whoſe careſſes, however, were all to no purpoſe. His behaviour afterwards to the Perſian captive ſhows him to have had a great command over himſelf in this particular. The wife of Darius was a finiſhed beauty; her daughters likewiſe were all beauties; yet this young prince, who had them in his power, not only beſtowed on them all the honours due to their high rank, but managed their reputation with the utmoſt delicacy. They were kept as in a cloiſter concealed from the world, and ſecured from the reach of every diſhonourable (not only attack, but) imputation. He did not give the leaſt handle to ſcandal, either by his viſits, his looks, or his words: and for other Perſian dames his priſoners, equally beautiful in face and ſhape, he contented himſelf with ſaying gayly, that they gave indeed much pain to his eyes. The amazon Thaleſtris could not obtain from him a compliance with her gallant requeſt till after a delay of thirteen days. In the mean time, what are we to conclude from his cauſing his favourite miſtreſs Pancaſte to be drawn naked by Apelles, though it is true he gave her to the painter, who fell in love with her? What of that immoderate love of boys, which Athenæus relates of him? What of that prodigious number of wives and concubines which he kept?

His exceſſes with regard to wine were notorious, and beyond all imagination; and he committed, when drunk, a thouſand extravagances. It was owing to wine, that he killed Clitus who ſaved his life, and burnt Perſepolis, one of the moſt beautiful cities of the Eaſt: he did this laſt indeed at the inſtigation of the courtezan Thais; but this circumſtance made it only the more heinous. It is generally believed, that he died by drinking immoderately: and even Plutarch, who affects to contradict it, owns that he did nothing but drink the whole day he was taken ill.

In ſhort, to ſum up the character of this prince, we cannot be of opinion, that his good qualities did in anywiſe compenſate for his bad ones. Heroes make a noiſe: their actions glare, and ſtrike the ſenſes forcibly; while the infinite deſtruction and miſery they occaſion lie more in the ſhade, and out of ſight. One good legiſlator is worth all the heroes that ever did or will exiſt. See Macedon.

Alexander ab Alexandro, a Neapolitan lawyer, of great learning, who flouriſhed toward the end of the 15th and beginning of the 16th century. He followed the profeſſion of the law firſt at Naples, afterwards at Rome: but he devoted all the time he could ſpare to the ſtudy of polite literature; and at length he entirely left the bar, that he might lead a more eaſy and agreeable life with the Muſes. The particulars of his life are to be gathered from his work entitled "Dies Geniales:" We are there informed, that he lodged at Rome, in a houſe that was haunted; and he relates many ſurpriſing particulars about the ghoſt. He ſays alſo, that when he was very young, he went to the lectures of Philelphus, who explained at Rome the Tuſculan queſtions of Cicero; he was there alſo when Nicholas Perot and Domitius Calderinus read their lectures upon Martial. The particular time when he died is not known; but he was buried in the monaſtery of the Olivets. Tiraquea wrote a learned commentary upon his work, which was printed at Lyons in 1587, and reprinted at Leyden, in 1673, with the notes of Dennis Godfrey, Chriſtopher Colerus, and Nicholas Mercerus.

Alexander, *Neckham*, an eminent Engliſh writer in the 12th and 13th centuries, born at St Albans in Hertfordſhire. In 1215 he was made abbot of Exeter, and died in 1227. He wrote ſeveral works, which were never publiſhed; but they are to be found in manuſcript in the libraries of England and other countries.

Alexander, *Noel*, an indefatigable writer of the 17th century, born at Rouen in Normandy, 1639. After finiſhing his ſtudies at Rouen, he entered into the order of Dominican friars, and was profeſſed there in 1655. Soon after he went to Paris, to go through a courſe of philoſophy and divinity in the great convent, where he diſtinguiſhed himſelf ſo, that he was appointed to teach philoſophy there, which he did for 12 years. M. Colbert ſhowed him many marks of his eſteem; and being determined to omit nothing to perfect the education of his ſon, afterwards archbiſhop of Rouen, he formed an aſſembly of the moſt learned perſons, whoſe conferences upon eccleſiaſtical hiſtory might be of advantage to him. Father Alexander was invited to this aſſembly, where he exerted himſelf with ſo much genius and ability, that he gained the particular friendſhip of young Colbert, who ſhowed him the utmoſt regard as long as he lived. Theſe conferences gave riſe to Alexander's deſign of writing an eccleſiaſtical hiſtory; for, being deſired to reduce what was material in theſe conferences to writing, he did it with ſo much accuracy, that the learned men who compoſed this aſſembly, adviſed him to undertake a complete body of church hiſtory. This he executed with great aſſiduity, collecting and digeſting the materials himſelf, and writing even the tables with his own hand. He at laſt completed his work in 1686. Towards the latter part of his life, he was afflicted with the loſs of his ſight; a moſt inexpreſſible misfortune to one whoſe whole pleaſure was in ſtudy, yet he bore it with great patience and reſignation. He died merely of a decay of nature, 1724, in the 86th year of his age.

Alexander Severus, emperor of Rome, ſucceeded Heliogabalus about A. D. 222, when but 16 years of age. His mother's name was Mammæa, and by her advice he in a great meaſure regulated his conduct. He applied himſelf to the reformation of abuſes, the ſtate having been greatly diſordered by the vicious conduct of his predeceſſor; he was a moſt ſtrict lover of juſtice, an encourager of learning and learned men, and favourable to the Chriſtians. He made a ſucceſsful expedition againſt the Perſians; but endeavouring to reform his troops, who had grown very licentious under the late bad government, they murdered him at the inſtigation of Maximinus, in the 29th year of his age, together with his mother, A. D. 235.

Alexander VI. *Pope*, had four baſtards when he was cardinal, for one of which he had ſo great affection, that he ſtuck at nothing to raiſe him. Deſigning to poiſon ſome cardinals, he was poiſoned himſelf, A. D. 1503. See Borgia.

Alexander VII. *Pope*. See Chigi.

Alexander biſhop of Lincoln in the reigns of Henry I. and Stephen, was a Norman by birth, and nephew

phew of the famous Roger, bishop of Salisbury, who first made him archdeacon of Salisbury, and afterwards, by his interest with the king, raised him to the mitre. Alexander was consecrated at Canterbury, July 22. 1123. Having received his education under his uncle the bishop of Salisbury, and been accustomed to a splendid way of living, he affected show and state more than was suitable to his character, or consistent with his fortunes. This failing excepted, he was a man of worth and honour, and every way qualified for his station. The year after his consecration, his cathedral church at Lincoln having been accidentally burnt down, he rebuilt it, and secured it against the like accident for the future by a stone roof. This prelate increased the number of prebends in his church, and augmented its revenues with several manors and estates. In imitation of the barons and some of the bishops, particularly his uncle the bishop of Salisbury, he built three castles; one at Banbury, another at Sleaford, and a third at Newark. He likewise founded two monasteries; one at Haverholm, for regular canons and nuns together, the other at Tame for white friars. He went twice to Rome in the years 1142 and 1144. The first time, he came back in quality of the pope's legate, for the calling a synod, in which he published several wholesome and necessary canons. In August 1147, he took a third journey to the pope, who was then in France; where he fell sick through the excessive heat of the weather, and returning with great difficulty to England, where he died in the 24th year of his prelacy.

Alexander, *William*, earl of Stirling, an eminent Scots statesman and poet in the reigns of James VI. and Charles I. who, after travelling with the duke of Argyle as his tutor or companion, wrote a poetical complaint of his unsuccessful love of some beauty, under the title of *Aurora*. He then removed to the court of James VI. where he applied to the more solid parts of poetry, forming himself upon the plan of the Greek and Roman tragedians. In 1607, he published some dramatic performances, entitled *The Monarchic Tragedies*, dedicated to King James; who was so well pleased with them, as to call him his philosophical poet. After this, he is said to have written *A supplement* to complete the third part of Sir Philip Sidney's Arcadia; and in 1613, he produced a poem called *Doomsday*, or *the Great Day of Judgment*. He was made gentleman usher to Prince Charles, and master of the requests; was knighted; and obtained a grant of Nova Scotia, where he projected the settlement of a colony, but afterwards sold it to the French. In 1626, he was made secretary of state for Scotland; was created first viscount, and then earl, of Stirling; and died in 1640.

Alexander I. *St*, whom St Irenæus reckons the fifth bishop of Rome, succeeded St Evaristus in the year 109, and died in the year 119. There is no account of his life; and the epistles which are attributed to him are suppositious.

Alexander II. king of Scotland, succeeded his father William in 1213, at 16 years of age. He made an expedition into England, to oppose the tyranny of King John; who returned the visit, and was offered battle by Alexander, but refused it. He took the city of Carlisle from Henry III. which was afterwards exchanged for Berwick. Alexander died in 1249, in the 51st year of his age, and 35th of his reign; and left for his successor, his son——

Alexander III. who was crowned king of Scotland in 1249. The Cummings, a powerful family, took arms against him; and taking him prisoner, confined him at Stirling: but he was afterwards released by his subjects. He married the daughter of Henry III. king of England; and was at length killed by a fall from his horse, on the 10th of April 1290, after having reigned 42, or according to others 37, years.

ALEXANDERS, in *Botany*. See Smyrnium.

ALEXANDRETTA, by the Turks called *Scanderoon*; a town in Syria, at the extremity of the Mediterranean sea. It is the port of Aleppo, from which it is distant 28 or 30 leagues. It is now, properly speaking, nothing else but a village, without walls, in which the tombs are more numerous than the houses, and which entirely owes its existence to the road which it commands. This is the only road, in all Syria, where vessels anchor on a solid bottom, without their cables being liable to chafe: but in other respects it has many inconveniences. It is infested, during winter, by a peculiar wind, called by the French sailors *le Raguier*, which, rushing from the snowy summits of the mountains, frequently forces ships to drag their anchors several leagues: And when the snow begins to cover the mountains which surround the gulf, tempestuous winds arise which prevent vessels from entering for three or four months together. The road also to Aleppo by the plain is invested by Curd robbers, who conceal themselves in the neighbouring rocks, and frequently attack and plunder the strongest caravans. But the worst circumstance is the extreme unwholesomeness of the air, occasioned here by stagnant waters and mephitic exhalations. It may be affirmed that this every year carries off one-third of the crews of the vessels which remain here during the summer; nay, ships frequently lose all their men in two months. The season for this epidemic disorder is principally from May to the end of September: it is an intermitting fever of the most malignant kind; and is accompanied with obstructions of the liver, which terminate in dropsy. To this baneful epidemic, Alexandretta, from its situation, seems to be irremediably condemned: for the plain on which the town is built is so low and flat, that the rivulets, finding no declivity, can never reach the sea. When they are swelled by the winter rains, the sea, swelled likewise by tempests, hinders their discharging themselves into it: hence their waters, forced to spread themselves, form lakes in the plain. On the approach of the summer, the waters becoming corrupted by the heat, exhale vapours equally corrupt, and which cannot disperse, being confined by the mountains that encircle the gulf. The entrance of the bay besides lies to the west, which in those countries is the most unhealthy exposure when it corresponds with the sea. The labour necessary to remedy this would be immense, and after all insufficient; and, indeed, such an undertaking would be absolutely impossible under a government like that of the Turks. A few years ago, Mr Volney informs us, the merchants of Aleppo, disgusted with the numerous inconveniences of Alexandretta, wished to abandon that port and carry the trade

Alexandretta, Alexandria.

to Latakia. They proposed to the pacha of Tripoli to repair the harbour at their own expence, provided he would grant them an exemption from all duties for ten years. To induce him to comply with their request, the agent they employed talked much of the advantage which would, *in time*, result to the whole country: "But what signifies it to me what may happen *in time*, replied the pacha? I was yesterday at Marach; to-morrow, perhaps, I shall be at Djedda: Why should I deprive myself of present advantages, which are certain, for future benefits I cannot hope to partake?" The European factors were obliged therefore to remain at Scanderoon. There are three of these factors, two for the French, and one for the English and Venetians. The only curiosity which they have to amuse strangers with consists in six or seven marble monuments, sent from England, on which you read: *Here lies such a one, carried off in the flower of his age, by the fatal effects of a contagious air.* The sight of these is the more distressing, as the languid air, yellow complexion, livid eyes, and dropsical bellies of those who show them, make it but too probable they cannot long escape the same fate. It is true, they have some resource in the village of Bailan, the pure air and excellent waters of which surprisingly restore the sick. The aga, for some years past, has applied the duties of the customhouse of Alexandretta to his own use, and rendered himself almost independent of the pacha of Aleppo. The Turkish empire is full of rich rebels, who frequently die in peaceable possession of their usurpations.

ALEXANDRIA, in *Ancient Geography*, a mountain of Mysia, on the sea coast, forming a part of Mount Ida, where Paris gave judgment on the three goddesses.

ALEXANDRIA, now *Scanderia*, by Athenæus called Χρυση; a city of Lower Egypt, and for a long time its capital. This city was built by Alexander the Great, soon after the overthrow of Tyre, about 333 years before Christ. It is situated on the Mediterranean, twelve miles west of that mouth of the Nile anciently called *Canopicum*; and lies in E. Long. 30. 9. N. Lat. 31. 10.

Alexander is said to have been induced to build this city, on account of its being conveniently situated for a fine port; and so sudden was his resolution, that after he had directed where every public structure was to be placed, fixed the number of temples, and the deities to whom they should be dedicated, &c. there were no instruments at hand proper for marking out the walls, according to the custom of those times. Upon this, a workman advised the king to collect what meal was among the soldiers, and to sift it in lines upon the ground, whereby the circuit of the walls would be sufficiently marked out. This advice was followed; and the new method of marking out the walls was, by Aristander, the king's soothsayer, interpreted as a presage of the city's abounding with all the necessaries of life. Nor was he deceived in his prediction; for Alexandria soon became the staple, not only for merchandise, but also for all the arts and sciences of the Greeks.

Alexandria was a league and a half long, by one-third in breadth, which made the circumference of its walls about four leagues. Lake Mareotis bathed its walls on the south, and the Mediterranean on the north. It was intersected lengthwise by straight parallel streets. This direction left a free passage to the northerly wind, which alone conveys coolness and salubrity into Egypt. A street of 2000 feet wide began at the gate of the sea, and terminated at the gate of Canopus. It was decorated with magnificent houses, temples, and public buildings. In this extensive range, the eye was never tired with admiring the marble, the porphyry and the obelisks, which were destined at some future day to embellish Rome and Constantinople. This street, the handsomest in the universe, was intersected by another of the same breadth, which formed a square at their junction of half a league in circumference. From the middle of this great place, the two gates were to be seen at once, and vessels arriving under full sail from the north and from the south.

A mole of a mile in length stretched from the continent to the isle of Pharos, and divided the great harbour into two. That which is to the northward preserved its name. A dike drawn from the island to the rock whereon was built the Pharos, secured it from the westerly winds. The other was called *Eunostos*, or the Safe Return. The former is called at present the new, the latter the old harbour: a bridge that joins the mole to the city, served for a communication between them. It was raised on lofty pillars sunk into the sea, and left a free passage for ships. The palace, which advanced beyond the promontory of *Lochias*, extended as far as the dike, and occupied more than a quarter of the city. Each of the Ptolemies added to its magnificence. It contained within its inclosure, the museum, an asylum for learned men, groves, and buildings worthy of royal majesty, and a temple where the body of Alexander was deposited in a golden coffin. The infamous Seleucus Cibyofactes violated this monument, carried off the golden coffin, and put a glass one in its place. In the great harbour was the little island of Anti-Rhodes, where stood a theatre, and a royal place of residence. Within the harbour of Eunostos was a smaller one, called *Kibotos*, dug by the hand of man, which communicated with Lake Mareotis by a canal. Between this canal and the palace was the admirable temple of Serapis, and that of Neptune near the great place where the market was held. Alexandria extended likewise along the southern banks of the lake. Its eastern part presented to view the gymnasium, with its porticoes of more than 600 feet long, supported by several rows of marble pillars. Without the gate of Canopus was a spacious circus for the chariot races. Beyond that, the suburb of Nicopolis ran along the seashore, and seemed a second Alexandria. A superb amphitheatre was built there with a race-ground, for the celebration of the quinquennalia.

Such is the description left us of Alexandria by the ancients, and above all by Strabo.

The architect employed by Alexander in this undertaking was the celebrated Dinocrates, who had acquired so much reputation by rebuilding the temple of Diana at Ephesus. The city was first rendered populous by Ptolemy Soter, one of Alexander's captains, who, after the death of the Macedonian monarch, being appointed governor of Egypt, soon assumed the title of king, and took up his residence at Alexandria, about 304 years before Christ.

In

Alexandria. In the 30th year of Ptolemy Soter's reign, he took his son Ptolemy Philadelphus partner with him in the empire; and by this prince the city of Alexandria was much embellished. In the first year of his reign the famous watch-tower of Pharos was finished. It had been begun several years before by Ptolemy Soter; and, when finished, was looked upon as one of the wonders of the world. The same year, the island of Pharos itself, originally seven furlongs distant from the continent, was joined to it by a causeway. This was the work of Dexiphanes, who completed it at the same time that his son put the last hand to the tower. The tower was a large square structure of white marble; on the top of which fires were kept constantly burning, for the direction of sailors. The building cost 800 talents; which, if Attic, amounted to 165,000l.; if Alexandrian, to twice that sum.

The architect employed in this famous structure fell upon the following contrivance to usurp the whole glory to himself.—Being ordered to engrave upon it the following inscription, "King PTOLEMY to the Gods the Saviours, for the benefit of Sailors;" instead of the king's name he substituted his own, and then filling up the hollow of the marble with mortar, wrote upon it the above-mentioned inscription. In process of time, the mortar being worn off, the following inscription appeared: "SOSTRATUS the CNIDIAN, the son of DEXIPHANES, to the Gods the Saviours, for the benefit of Sailors."

This year also was remarkable for the bringing of the image of Serapis from Pontus to Alexandria. It was set up in one of the suburbs of the city called *Rhacotis*, where a temple was afterwards erected to his honour, suitable to the greatness of that stately metropolis, and called, from the god worshipped there, *Serapeum*. This structure, according to Ammianus Marcellinus, surpassed in beauty and magnificence all others in the world, except the capitol at Rome.—— Within the verge of this temple was the famous Alexandrian library. It was founded by Ptolemy Soter, for the use of an academy he instituted in this city; and, by continual additions by his successors, became at last the finest library in the world, containing no fewer than 700,000 volumes. The method followed in collecting books for this library, was, to seize all those which were brought into Egypt by Greeks or other foreigners. The books were transcribed in the museum by persons appointed for that purpose; the copies were then delivered to the proprietors, and the originals laid up in the library. Ptolemy Euergetes, having borrowed from the Athenians the works of Sophocles, Euripides, and Æschylus, returned them only the copies, which he caused to be transcribed in as beautiful a manner as possible; presenting the Athenians at the same time with fifteen talents (upwards of 3000l. sterling) for the exchange.

As the museum was at first in that quarter of the city called *Bruchion*, near the royal palace, the library was placed there likewise; but when it came to contain 400,000 volumes, another library, within the Serapeum, was erected by way of supplement to it, and on that account called the *daughter* of the former. In this second library 300,000 volumes, in process of time, were deposited; and the two together contained the 700,000 volumes already mentioned. In the war carried on by Julius Cæsar against the inhabitants of this city, the library in the Bruchion, with the 400,000 volumes it contained, was reduced to ashes. The library in the Serapeum, however, still remained; and here Cleopatra deposited 200,000 volumes of the Pergamean library, which Marc Antony presented her with. These, and others added from time to time, rendered the new library at Alexandria more numerous and considerable than the former; and though it was often plundered during the revolutions and troubles of the Roman empire, yet it was again and again repaired, and filled with the same number of books.

For 293 years Alexandria was held in subjection by the Ptolemies. Here is a list of these princes, with the dates of their respective reigns.

Ptolemy the son of Lagus, surnamed *Soter*, reigned 39 years, and died in the year of the world 3720. Ptolemy Philadelphus reigned 39 years, and died in 3758. Ptolemy Euergetes reigned 25 years, and died in 3783. Ptolemy Philopater reigned 17 years, and died in 3800. Ptolemy Epiphanes reigned 24 years, and died in 3824. Ptolemy Philometor reigned 37 years, and died in 3861. Ptolemy Euergetes, or Physcon, reigned 53 years, part with his brother Philometor and part alone. He died in 3888. Ptolemy Lathyrus reigned 36 years six months. He died in 3923. Cleopatra, the daughter of Lathyrus and wife of Alexander I. reigned six months. Alexander I. the nephew of Lathyrus, was established in 3924, and died in 3943. Alexander II. the son of Alexander I. was dispossessed by the Alexandrians in 3939. Ptolemy Nothus, or Auletes, the son of Lathyrus, reigned 13 years, and died in 3953. Ptolemy, surnamed *Dionysius* or *Bacchus*, reigned three years eight months, and died in 3957. Cleopatra reigned from 3957, and killed herself in 3974.

This city, as we have already observed, soon became extremely populous, and was embellished both by its own princes and the Romans; but, like most other noted cities of antiquity, hath been the seat of terrible massacres. About 141 years before Christ, it was almost totally depopulated by Ptolemy Physcon. That barbarous monster, without the least provocation, gave free liberty to his guards to plunder his metropolis and murder the inhabitants at their pleasure. The cruelties practised on this occasion cannot be expressed; and the few who escaped were so terrified that they fled into other countries. Upon this, Physcon, that he might not reign over empty houses, invited thither strangers from the neighbouring countries; by whom the city was repeopled, and soon recovered its former splendour. On this occasion many learned men having been obliged to fly, proved the means of reviving learning in Greece, Asia Minor, the islands of the Archipelago, and other places, where it was almost totally lost.

The new inhabitants were not treated with much more kindness by Physcon than the old ones had been; for, on their complaining of his tyrannical behaviour, he resolved on a general massacre of the young men. Accordingly, when they were one day assembled in the gymnasium, or place of their public exercises, he ordered it to be set on fire; so that they all perished, Alexandria. ed, either in the flames, or by the ſwords of his mercenaries, whom the tyrant had placed at all the avenues.

Though Julius Cæſar was obliged to carry on a war for ſome time againſt this city, it ſeems not to have ſuffered much damage, except the burning of the library already mentioned. Before Cæſar left Alexandria, in acknowledgment of the aſſiſtance he had received from the Jews, he confirmed all their privileges there, and even engraved his decree on a pillar of braſs. This, however, did not prevent the maſſacre of 50,000 of them in this city about the year of Chriſt 67.

The city of Alexandria ſeems to have fallen into decay ſoon after this, and to have forfeited many of its ancient privileges, though for what offence is not known; but when Adrian viſited Egypt, about the year 141, it was almoſt totally ruined. He repaired both the public and private buildings, not only reſtoring the inhabitants to their ancient privileges, but heaping new favours upon them; for which they returned him their ſolemn thanks, and conferred upon him what honours they could while he was preſent; but as ſoon as he was gone, they publiſhed the moſt bitter and virulent lampoons againſt him.

The fickle and ſatirical humour of the Alexandrians was highly diſliked by Adrian, though he inflicted no puniſhment upon them for it; but when they lampooned Caracalla, he did not let them eſcape ſo eaſily. That tyrant, in the year 215, when he viſited their city, having become the ſubject of their fooliſh ſatires, ordered a general maſſacre by his numerous troops, who were diſperſed all over the city. The inhuman orders being given, all were murdered, without diſtinction of age or ſex; ſo that in one night's time the whole city floated in blood, and every houſe was filled with carcaſes. The monſter who occaſioned this had retired during the night to the temple of Serapis, to implore the protection of that deity; and, not yet ſatiated with ſlaughter, commanded the maſſacre to be continued all the next day; ſo that very few of the inhabitants remained. As if even this had not been ſufficient, he ſtripped the city of all its ancient privileges; ſuppreſſed the academy; ordered all ſtrangers who lived there to depart; and that the few who remained might not have the ſatisfaction of ſeeing one another, he cut off all communication of one ſtreet with another, by walls built for that purpoſe, and guarded by troops left there.

Notwithſtanding this terrible diſaſter, Alexandria ſoon recovered its former ſplendour, as Caracalla was murdered a ſhort time after. It was long eſteemed the firſt city in the world, next to Rome; and we may judge of its magnificence, and the multitude of people contained in it, from the account of Diodorus Siculus, who relates, that in his time (44 years before Chriſt) Alexandria had on its rolls 300,000 freemen. Towards the middle of the ſixth century, Amrou *Ebn al Aas*, Omar's general, took it by ſtorm, after a ſiege of 14 months, and with the loſs of 23,000 men. Heraclius, then emperor of Conſtantinople, did not ſend a ſingle ſhip to its aſſiſtance. This prince affords an example very rare in hiſtory; he had diſplayed ſome vigour in the firſt year of his reign, and then ſuffered himſelf to be lulled into idleneſs and effeminacy. Awakened ſuddenly from his lethargy by the noiſe of the conqueſts of Coſroes, that ſcourge of the eaſt, he Alexandria. put himſelf at the head of his armies, diſtinguiſhed himſelf as a great captain from his very firſt campaign, laid waſte Perſia for ſeven years, and returned to his capital covered with laurels: he then became a theologian on the throne, loſt all his enegry, and amuſed himſelf the reſt of his life with diſputing upon Monotheiſm, whilſt the Arabs were robbing him of the fineſt provinces of his empire. Deaf to the cries of the unfortunate inhabitants of Alexandria, as he had been to thoſe of the people of Jeruſalem, who defended themſelves for two years, he left them a ſacrifice to the fortunate aſcendant of the indefatigable Amrou. All their intrepid youth periſhed with their arms in their hands.

The victor, aſtoniſhed at his conqueſt, wrote to the caliph, " I have taken the city of the weſt. It is of an immenſe extent. I cannot deſcribe to you how many wonders it contains. There are 4000 palaces, 4000 baths, 12,000 dealers in freſh oil, 12,000 gardeners, 40,000 Jews who pay tribute, 400 theatres or places of amuſement."

At this time, according to the Arabian hiſtorians, Alexandria conſiſted of three cities, *viz. Menna*, or the port, which included Pharos, and the neighbouring parts; *Alexandria*, properly ſo called, where the modern Scanderia now ſtands; and *Nekita*, probably the Necropolis of Joſephus and Strabo.

At that time John, ſurnamed *the grammarian*, a famous Peripatetic philoſopher, being in the city, and in high favour with Amrou Ebn al Aas the Saracen general, begged of him the royal library. Amrou replied, that it was not in his power to grant ſuch a requeſt; but that he would write to the caliph on that head; ſince, without knowing his pleaſure, he dared not to diſpoſe of a ſingle book. He accordingly wrote to Omar, who was then caliph, acquainting him with the requeſt of his friend: To which the ignorant tyrant replied, That if thoſe books contained the ſame doctrine with the Koran, they could be of no uſe, ſince the Koran contained all neceſſary truths; but if they contained any thing contrary to that book, they ought not to be ſuffered; and therefore, whatever their contents were, he ordered them to be deſtroyed. Purſuant to this order, they were diſtributed among the public baths; where, for the ſpace of ſix months, they ſerved to ſupply the fires of thoſe places, of which there was an incredible number in Alexandria.

After the city was taken, Amrou thought proper to purſue the Greeks who had fled farther up the country; and therefore marched out of Alexandria, leaving but a very ſlender garriſon in the place. The Greeks, who had before fled on board their ſhips, being appriſed of this, returned on a ſudden, ſurpriſed the town, and put all the Arabs they found therein to the ſword: but Amrou, receiving advice of what had happened, ſuddenly returned, and drove them out of it with great ſlaughter; after which the Greeks were ſo intimidated, that he had nothing farther to fear from them.—A few years after, however, Amrou being deprived of his government by the caliph Othman, the Egyptians were ſo much diſpleaſed with his diſmiſſion that they inclined to a revolt; and Conſtantine the Greek emperor, having received intelligence of their diſaffection, began to meditate the reduction of Alexandria. For this purpoſe, he

Alexandria. he ſent one Manuel, an eunuch, and his general, with a powerful army, to retake that place; which, by the aſſiſtance of the Greeks in the city, who kept a ſecret correſpondence with the imperial forces while at ſea, and joined them as ſoon as they had made a deſcent, he effected, without any conſiderable effuſion of Chriſtian blood. The caliph, now perceiving his miſtake, immediately reſtored Amrou to his former dignity. This ſtep was very agreeable to the natives; who having had experience of the military ſkill and bravery of this renowned general, and apprehending that they ſhould be called to an account by the Greeks for their former perfidious conduct, had petitioned Othman to ſend him again into Egypt.—Upon Amrou's arrival, therefore, at Alexandria, the Copts or natives, with the traitor Al-Mokawkas (who had formerly betrayed to Amrou the fortreſs of Meſr) at their head, not only joined him, but ſupplied him with all kinds of proviſions, exciting him to attack the Greeks without delay. This he did; and, after a moſt obſtinate diſpute which laſted ſeveral days, drove them into the town, where, for ſome time, they defended themſelves with great bravery, and repelled the utmoſt efforts of the beſiegers. This ſo exaſperated Amrou, that he ſwore, "If God enabled him to conquer the Greeks, he would throw down the walls of the city, and make it as eaſy of acceſs as the houſe of a proſtitute. Nor did he fail to execute his threat; for having taken the town by ſtorm, he quite diſmantled it, entirely demoliſhing the walls and fortifications. The lives of the citizens, however, were ſpared, at leaſt as far as lay in the general's power; but many of them were put to the ſword by the ſoldiers on their firſt entrance. In one quarter particularly, Amrou found them butchering the Alexandrians with unrelenting barbarity; to which, however, by his ſeaſonable interpoſition, he put a ſtop, and on that ſpot erected a moſque, which he called the *moſque of mercy*.

From this time Alexandria never recovered its former ſplendour. It continued under the dominion of the caliphs till the year 924, when it was taken by the Magrebians, two years after its great church had been deſtroyed by fire. This church was called by the Arabs *Al Kaiſaria*, or *Cæſarea*; and had formerly been a pagan temple, erected in honour of Saturn by the famous queen Cleopatra.

The city was ſoon after abandoned by the Magrebians; but in 928 they again made themſelves maſters of it; their fleet being afterwards defeated by that belonging to the caliph, *Abul Kaſem* the Magrebian general retired from Alexandria, leaving there only a garriſon of 300 men; of which *Thmaâl*, the caliph's admiral, being appriſed, he in a few days appeared before the town, and carried off the remainder of the inhabitants to an iſland in the Nile called *Abukair*. This was done to prevent Abul Kâſem from meeting with any entertainment at Alexandria, in caſe he ſhould think proper to return. According to Eutychius, above 200,000 of the miſerable inhabitants periſhed this year.

What contributed to raiſe Alexandria to ſuch a prodigious height of ſplendour as it enjoyed for a long time, was its being the centre of commerce between the eaſtern and weſtern parts of the world. It was with the view of becoming maſter of this lucrative trade, that Alexander built this city, after having extirpated the Tyrians who formerly engroſſed all the Eaſt India traffic. Of the immenſe riches which that trade afforded, we may form an idea, from conſidering that the Romans accounted it a point of policy to oppreſs the Egyptians, eſpecially the Alexandrians; and after the defeat of Zenobia, there was a ſingle merchant of Alexandria who undertook to raiſe and pay an army out of the profits of his trade. The Greek emperors drew prodigious tributes from Egypt, and yet the caliphs found their ſubjects in ſo good circumſtances as to ſcrew up their revenues to three hundred millions of crowns.

Though the revolutions which happened in the government of Egypt, after it fell into the hands of the Mahometans, frequently affected this city to a very great degree; yet ſtill the excellence of its port, and the innumerable conveniences reſulting from the Eaſt India trade, to whomſoever were maſters of Egypt, preſerved Alexandria from total deſtruction, even when in the hands of the moſt barbarous nations. Thus, in the 13th century, when the barbariſm introduced by the Goths, &c. began to wear off from the European nations, and they acquired a taſte for the elegancies of life, the old mart of Alexandria began to revive; and the port, though far from recovering its former magnificence, grew once more famous by becoming the centre of commerce: but having fallen under the dominion of the Turks, and the paſſage round the Cape of Good Hope being diſcovered by the Portugueſe in 1499, a fatal blow was given to the Alexandrian commerce, and the city has ſince fallen into decay.

At preſent, the city of Alexandria is reckoned to have about 14,000 or 15,000 inhabitants; a ſtrange colluvies of different nations, as well as from various parts of the Turkiſh empire. They are in general given to thieving and cheating; and (like their predeceſſors) ſeditious above all others, were they not kept in awe by the ſeverity of their government. The Britiſh and French carry on a conſiderable commerce with them, and have each a conſul reſiding here. Some Venetian ſhips alſo ſail thither yearly, but with French colours, and under the protection of France. The ſubjects of thoſe kingdoms which keep no conſul here, are ſubjected to a tax by the Grand Signior: but the Jews have found out a method of indemnifying themſelves for this diſadvantage; namely, by ſelling their commodities cheaper than other foreigners can afford. They are alſo favoured by the farmers of the revenue; who know, that if they do not pay ſome private regard to them, the Jews have it in their power to cauſe fewer merchandiſes come into their port during the two years that their farm laſts.

The preſent city is a kind of peninſula ſituated between the two ports. That to the weſtward was called by the ancients the *Portus Eunoſtus*, now the *Old Port*, and is by far the beſt; Turkiſh veſſels only are allowed to anchor there: the other called the *New Port*, is for the Chriſtians; at the extremity of one of the arms of which ſtood the famous Pharos. The New Port, the only harbour for Europeans, is clogged up with ſand, inſomuch that in ſtormy weather ſhips are liable to bilge; and the bottom being alſo rocky, the cables ſoon chafe and part; ſo that one veſſel driving againſt a ſecond, and that againſt a third, they are perhaps all loſt. Of this there was a fatal inſtance ſome years ago, when 42 veſſels were daſhed to pieces on the mole

in

Alexandria. in a gale of wind from the north-weſt, and numbers have been ſince loſt there at different times. If it be aſked in Europe, Why do they not repair the New Port? the anſwer is, That in Turkey they deſtroy every thing, and repair nothing. The old harbour will be deſtroyed likewiſe, as the ballaſt of veſſels has been continually thrown into it for the laſt 200 years. The ſpirit of the Turkiſh government is to ruin the labours of paſt ages, and deſtroy the hopes of future times, becauſe the barbarity of ignorant deſpotiſm never conſiders to-morrow.

In time of war, Alexandria is of no importance; no fortification is to be ſeen; even the Farillon, with its lofty towers, cannot be defended. It has not four cannon fit for ſervice, nor a gunner who knows how to point them. The 500 janizaries, who ſhould form the garriſon, reduced to half that number, know nothing but how to ſmoke a pipe. But Alexandria is a place of which the conqueſt would be of no value. A foreign power could not maintain itſelf there, as the country is without water. This muſt be brought from the Nile by the kalidj, or canal of 12 leagues, which conveys it thither every year at the time of the inundation. It fills the vaults or reſervoirs dug under the ancient city, and this proviſion muſt ſerve till the next year. It is evident, therefore, that were a foreign power to take poſſeſſion, the canal would be ſhut, and all ſupplies of water cut off. It is this canal alone which connects Alexandria with Egypt; for from its ſituation without the Delta, and the nature of the ſoil, it really belongs to the deſerts of Africa. Its environs are ſandy, flat, and ſterile, without trees and without houſes; where we meet with nothing but the plant which yields the kali, and a row of palm trees which follows the courſe of the kalidj or canal.

The city is governed like others in the ſame kingdom. (See Egypt.) It hath a ſmall garriſon of ſoldiers, part of which are Janizaries and Aſſaffs; who are very haughty and inſolent, not only to ſtrangers, but to the mercantile and induſtrious part of the people, though ever ſo conſiderable and uſeful. The government is ſo remiſs in favour of theſe wretches, that Mr Norden informs us, one of them did not heſitate to kill a farmer of the cuſtoms, for refuſing to take leſs of him than the duty impoſed, and went off unpuniſhed; it being a common ſalvo among them, that what is done cannot be undone.

The preſent condition of Alexandria is very deſpicable, being now ſo far ruined, that the rubbiſh in many places overtops the houſes. The famous tower of Pharos has long ſince been demoliſhed, and a caſtle, called *Farillon*, built in its place. The cauſeway which joined the iſland to the continent is broken down, and its place ſupplied by a ſtone bridge of ſeveral arches.

Some parts of the old walls of the city are yet ſtanding, and preſent us with a maſterpiece of ancient maſonry. They are flanked with large towers, about 200 paces diſtant from each other, with ſmall ones in the middle. Below are magnificent caſemates, which may ſerve for galleries to walk in. In the lower part of the towers is a large ſquare hall, whoſe roof is ſupported by thick columns of Thebaic ſtone. Above this are ſeveral rooms, over which there are platforms more than 20 paces ſquare. The ancient reſervoirs, vaulted with ſo much art, which extend under the whole town, are almoſt entire at the end of 2000 years.

Of Cæſar's palace there remain only a few porphyry pillars, and the front, which is almoſt entire, and looks very beautiful. The palace of Cleopatra was built upon the walls facing the port, having a gallery on the outſide, ſupported by ſeveral fine columns. Not far from this palace are two obeliſks vulgarly called *Cleopatra's Needles*. They are of Thebaic ſtone, and covered with hieroglyphics. One is overturned, broken, and lying under the ſand; the other is on its pedeſtal. Theſe two obeliſks, each of them of a ſingle ſtone, are about 60 feet high, by ſeven feet ſquare at the baſe. Denon, who went to Egypt along with the French army in 1798, ſuppoſes that theſe columns decorated the entrance of the palace of the Ptolemies, the ruins of which ſtill exiſt at no great diſtance from the place of the obeliſks. Towards the gate of Roſetta, are five columns of marble on the place formerly occupied by the porticoes of the gymnaſium. The reſt of the colonnade, the deſign of which was diſcoverable 100 years ago by Maillet, has ſince been deſtroyed by the barbariſm of the Turks.

But what moſt engages the attention of travellers is the pillar of Pompey, as it is commonly called, ſituated at a quarter of a league from the ſouthern gate. It is compoſed of red granite. The capital is Corinthian, with palm leaves, and not indented. It is nine feet high. The ſhaft and the upper member of the baſe are of one piece of 90 feet long, and 9 in diameter. The baſe is a ſquare of about 15 feet on each ſide. This block of marble, 60 feet in circumference, reſts on two layers of ſtone bound together with lead; which, however, has not prevented the Arabs from forcing out ſeveral of them, to ſearch for an imaginary treaſure. The whole column is 114 feet high. It is perfectly well poliſhed, and only a little ſhivered on the eaſtern ſide. Nothing can equal the majeſty of this monument; ſeen from a diſtance, it overtops the town, and ſerves as a ſignal for veſſels. Approaching it nearer, it produces an aſtoniſhment mixed with awe. One can never be tired with admiring the beauty of the capital, the length of the ſhaft, nor the extraordinary ſimplicity of the pedeſtal. This laſt has been ſomewhat damaged by the inſtruments of travellers, who are curious to poſſeſs a relick of this antiquity; and one of the volutes of the column was immaturely brought down about twelve years ago, by a prank of ſome Engliſh captains, which is thus related by Mr Irwin.

Theſe jolly ſons of Neptune had been puſhing about the can on board one of the ſhips in the harbour, until a ſtrange freak entered into one of their brains. The eccentricity of the thought occaſioned it immediately to be adopted; and its apparent impoſſibility was but a ſpur for the putting it into execution. The boat was ordered; and with proper implements for the attempt, theſe enterpriſing heroes puſhed aſhore, to drink a bowl of punch on the top of Pompey's pillar! At the ſpot they arrived; and many contrivances were propoſed to accompliſh the deſired point. But their labour was vain; and they began to deſpair of ſucceſs, when the genius who ſtruck out the frolic happily ſuggeſted the means of performing it. A man was diſpatched

Voyage and Route, p. 370.

Alexandria. patched to the city for a paper kite. The inhabitants were by this time apprized of what was going forward, and flocked in crowds to be witnesses of the address and boldness of the English. The governor of Alexandria was told that these seamen were about to pull down Pompey's pillar. But whether he gave them credit for their respect to the Roman warrior, or to the Turkish government, he left them to themselves; and politely answered, that the English were too great patriots to injure the remains of Pompey. He knew little, however, of the disposition of the people who were engaged in this undertaking. Had the Turkish empire risen in opposition, it would not perhaps at that moment have deterred them. The kite was brought, and flown so directly over the pillar, that when it fell on the other side, the string lodged upon the capital. The chief obstacle was now overcome. A two-inch rope was tied to one end of the string, and drawn over the pillar by the end to which the kite was affixed. By this rope one of the seamen ascended to the top; and in less than an hour a kind of shroud was constructed, by which the whole company went up, and drank their punch amid the shouts of the astonished multitude. To the eye below, the capital of the pillar does not appear capable of holding more than one man upon it; but our seamen found it could contain no less than eight persons very conveniently. It is astonishing that no accident befel these madcaps, in a situation so elevated, that would have turned a landman giddy in his sober senses. The only detriment which the pillar received, was the loss of the volute before mentioned; which came down with a thundering sound, and was carried to England by one of the captains, as a present to a lady who commissioned him for a piece of the pillar. The discovery which they made amply compensated for this mischief; as without their evidence, the world would not have known at this hour, that there was originally a statue on this pillar, one foot and ancle of which are still remaining. The statue must have been of a gigantic size; to have appeared of a man's proportion at so great an height.

There are circumstances in this story which might give it an air of fiction, were it not demonstrated beyond all doubt. Besides the testimonies of many eyewitnesses, the adventurers themselves have left us a token of the fact, by the initials of their names, which are very legible in black paint just beneath the capital.

Learned men and travellers have made many fruitless attempts to discover in honour of what prince it was erected. The best informed have concluded, that it could not be in honour of Pompey, since neither Strabo nor Diodorus Siculus have spoken of it. The Arabian Abulfeda, in his Description of Egypt, calls it *the Pillar of Severus*. And history informs us *, that this emperor "visited the city of Alexandria: That he granted a senate to its inhabitants, who until that time, under the subjection of a single Roman magistrate, had lived without any national council, as under the reign of the Ptolemies, when the will of the prince was their only law: That he did not confine his benefactions there; he changed several laws in their favour." This column, therefore, Mr Savary concludes to have been erected by the inhabitants as a mark of their gratitude to Severus. And in a Greek inscription, now half effaced, but visible on the west side when the sun shines upon it, and which probably was legible in the time of Abulfeda, he supposes the name of Severus to have been preserved. He further observes, that this was not the only monument erected to him by the gratitude of the Alexandrians: for there is still seen in the midst of the ruins of Antinoe, built by Adrian, a magnificent pillar, the inscription on which is still remaining, dedicated to Alexander Severus.

* Vide *Spartian's Life of Severus*, chap. 17.

Denon whom we have already quoted, seems to be of a different opinion. "We passed (says he) near Pompey's pillar. This monument is in the predicament of almost every thing famous, which loses on a near scrutiny. It was named Pompey's pillar in the fifteenth century, when learning began to recover itself from the torpid state in which it had so long languished. At that epoch, men of science, but not observers, bestowed names on all the monuments; and these names have been handed down by tradition, and without being disputed, from century to century. A monument had been raised to Pompey at Alexandria: it had disappeared, and was thought to be recovered in this pillar or column, which has since been converted into a trophy erected to the memory of Septimius Severus. It is, however, placed on the ruins of the ancient city; and in the time of Septimius Severus, the city of the Ptolemies was not in a ruinous state. To support this column by a solid foundation, an obelisk has been sunk in the earth, on which is placed a very clumsy pedestal, having a fine shaft, and surmounted by a Corinthian capital of bad workmanship.

"If the shaft of this column, separating it from the pedestal and the capital, once belonged to an ancient edifice, it is an evidence of its magnificence, and of the skill with which it was executed. It ought therefore to be said, that what is called Pompey's pillar, is a fine column, and not a fine monument. It should be said, that the column of St Maria Maggiore, notwithstanding it is one of the finest in existence, has not the character of a monument; that it is merely a fragment; and that, if the columns of Trajan and Antoninus are not in the same predicament, it is because they appear as colossal cylinders, on which the history of the glorious expeditions of these two emperors is pompously displayed, and which, if reduced to their simple form and dimensions, would be nothing more than dull and heavy monuments.

"The earth about the foundations of Pompey's pillar having been cleared away by time, two fragments of an obelisk of white marble, the only monument of that substance which I have seen in Egypt, have been added to the original base, to render it more solid.

"Excavations made round the circumference of this column, would, no doubt, afford some information relative to its origin. The shaking of the earth, and the form it takes on treading on it, seem to attest that these researches would not be fruitless. They would perhaps discover the base and *atrium* of the portico to which this column belonged, which has been the subject of dissertations made by literati who have seen the drawings only, or whose information has been limited to the descriptions of travellers. These travellers have neglected to apprize them, that fragments of columns of the same substance and diameter are found in the vicinity; and that the shaking of the earth indicates the destruction of great edifices buried beneath, the forms of which

Alexandria. which may be diſtinguiſhed on the ſurface, ſuch as a ſquare of a conſiderable ſize, and a large circus, the principal dimenſions of which may be meaſured, notwithſtanding it is covered with ſand and ruins.

"After having obſerved that the column, entitled *Pompey's pillar*, is very chaſte both in ſtyle and execution; that the pedeſtal and capital are not formed of the ſame granite as the ſhaft; that their workmanſhip is heavy, and appears to be merely a rough draught; and that the foundations, made up of fragments, indicate a modern conſtruction; it may be concluded, that this monument is not antique, and that it may have been erected either in the time of the Greek emperors, or of the caliphs; ſince, if the capital and pedeſtal are well enough wrought to belong to the former of theſe periods, they are not ſo perfect but that art may have reached ſo far in the latter." (*Denon's Travels.*)

On the ſouth-weſt ſide of the city, at a mile's diſtance, are ſituated the catacombs, the ancient burial-place of Alexandria; and although they cannot be compared to thoſe of the ancient Memphis, which the Arabs will not permit to be viſited, in order to make the better market of their mummies, it is probable that, the method of embalming being the ſame, the form of theſe catacombs can only differ in their proportions. The Baron de Tott, in deſcribing theſe, obſerves, "that Nature not having furniſhed this part of Egypt with a ridge of rocks, like that which runs parallel with the Nile above Delta, the ancient inhabitants of Alexandria could only have an imitation by digging into a bed of ſolid rock; and thus they formed *Necropolis*, or "City of the Dead." The excavation is from 30 to 40 feet wide, and 200 long, and 25 deep, and is terminated by gentle declivities at each end. The two ſides, cut perpendicularly, contain ſeveral openings, about 10 or 12 feet in width and height, hollowed horizontally; and which form, by their different branches, ſubterranean ſtreets. One of theſe, which curioſity has diſencumbered from the ruins and ſands that render the entrance of others difficult or impoſſible, contains no mummies, but only the places they occupied. The order in which they were ranged is ſtill to be ſeen. Niches, 20 inches ſquare, ſunk ſix feet horizontally, narrowed at the bottom, and ſeparated from each other by partitions in the rock, ſeven or eight inches thick, divide into checkers the two walls of this ſubterranean vault. It is natural to ſuppoſe, from this diſpoſition that each mummy was introduced with the feet foremoſt into the cell intended for its reception; and that new ſtreets were opened, in proportion as theſe dead inhabitants of Necropolis increaſed." This obſervation, he adds, which throws a light on the catacombs of Memphis, may perhaps likewiſe explain the vaſt ſize and multitude, as well as the different elevations, of the pyramids in the Higher and Lower Egypt.

About 70 paces from Pompey's pillar is the khalis or the canal of the Nile, which was dug by the ancient Egyptians, to convey the water of the Nile to Alexandria, and fill the ciſterns under the city. On the ſide of the khalis are gardens full of orange and lemon trees, and the fields are full of caper and palm trees. On the top of a hill is a tower, on which a ſentinel is always placed, to give notice, by means of a flag, of the ſhips that are coming into the port. From this hill may be ſeen the ſea, the whole extent of the city, and the parts round it. Alexandria.

In going along the ſea-coaſt, there is a large baſon cut out of the rock that lines the ſhore. On the ſides of this baſon, two beautiful ſaloons are hewn out by the chiſel, with benches that run acroſs them. A canal made zig-zag, for the purpoſe of ſtopping the ſand by its different windings, conveys into them the water of the ſea, as pure and tranſparent as cryſtal. Seated on the ſtone-bench, the water riſes a little above the waiſt; while the feet ſoftly repoſe on a fine ſand. The waves of the ſea are heard roaring againſt the rock, and foaming in the canal. The ſwell enters, raiſes you up, and leaves you; and thus alternately entering and retiring, brings a continual freſh ſupply of water, and a coolneſs which is truly delicious under a burning ſky. This place is vulgarly called the *Bath of Cleopatra*. Some ruins announce that it was formerly ornamented.

In 1798 Alexandria was taken by the French under the command of Bonaparte. It fell into the hands of the Britiſh army in the year 1801, but by an article in the treaty of peace, dictated probably by mutual jealouſy, it is to be reſtored to the Ottoman Porte, and again ſubjected to the barbarous policy of the Turkiſh government.

Alexandria is about 50 leagues north of Cairo. E. Long. 31. 15. N. Lat. 31. 12.

ALEXANDRIA, a ſtrong and conſiderable city of Italy, belonging to the duchy of Milan, with a good caſtle, built in 1178 in honour of Pope Alexander III. This pope made it a biſhopric, with ſeveral privileges and exemptions. Prince Eugene of Savoy took this city in 1706, after three days ſiege. The French took it in 1745; but the king of Sardinia, to whom it belongs by the treaty of Utrecht, retook it in 1746. The fortifications of the town are trifling, but the citadel is conſiderable. It is 15 miles ſouth-eaſt of Caſſal, 35 north-by-weſt of Genoa, and 40 ſouth-by-weſt of Milan. E. Long. 8. 40. N. Lat. 44. 53. The country about this town is called the *Alexandrin*.

ALEXANDRIA, in *Ancient Geography*, a city of Arachoſia, called alſo *Alexandropolis*, on the river Arachotus (Stephanus, Iſidorus Characenus).—Another *Alexandria* in Gedroſia, built by Leonatus, by order of Alexander (Pliny).—A third *Alexandria* in Aria, ſituated at the lake Arias (Ptolemy); but, according to Pliny, built by Alexander on the river Arius.—A fourth in Bactriana (Pliny).—A fifth *Alexandria*, an inland town of Carmania (Pliny, Ptolemy, Ammian).—A ſixth *Alexandria*, or *Alexandropolis*, in Sogdiana (Iſidorus Characenus).—A ſeventh in India, at the confluence of the Aceſines and Indus (Arrian).—An eighth, called alſo *Alexandretta*, near the Sinus Iſſicus, on the confines of Syria and Cilicia, now *Scanderoon* (ſee ALEXANDRETTA), the port town to Aleppo.—A ninth *Alexandria* of Margiana, which being demoliſhed by the barbarians, was rebuilt by Antiochus the ſon of Seleucus, and called *Antiochia* of Syria (Pliny); watered by the river Margus, which is divided into ſeveral channels, for the purpoſe of watering the country which was called *Zotale*. The city was ſeventy ſtadia in circuit, according to Pliny; who adds, that, after the defeat of Craſſus, the captives were conveyed to this place by Orodes, the king of the

Alexandrian, Alexicacus.

the Parthians.—A tenth, of the Oxiana, built on the Oxus by Alexander, on the confines of Bactria (Pliny).—An eleventh, built by Alexander at the foot of Mount Paropamisus, which was called *Caucasus* (Pliny, Arrian.)—A twelfth *Alexandria* in Troas, called also *Troas* and *Antigonia* (Pliny).—A thirteenth on the Iaxartes, the boundary of Alexander's victories towards Scythia, and the last that he built on that side.

ALEXANDRIAN, in a particular sense, is applied to all those who professed or taught the sciences in the school of Alexandria. In this sense, Clemens is denominated *Alexandrinus*, though born at Athens. The same may be said of Apion, who was born at Oasis; and Arostarchus, by birth a Samothracian. The chief Alexandrian philosophers were, Amonius, Plotinus, Origen, Porphyry, Jamblicus, Sopater, Maximus, and Dexippus.

Alexandrian is more particularly understood of a college of priests, consecrated to the service of Alexander Severus after his deification. Lampridius relates, that, notwithstanding Severus was killed by Maximin, the senate prosecuted his apotheosis; and, for regularity of worship, founded an order of priests, or *sodales*, under the denomination of *Alexandrini*.

Alexandrian Manuscript, a famous copy of the Scriptures, consisting of four volumes, in a large quarto size; which contains the whole Bible in Greek, including the Old and New Testament, with the Apocrypha, and some smaller pieces, but not quite complete. This manuscript is now preserved in the British Museum. It was sent as a present to King Charles I. from Cyrillus Lucaris, patriarch of Constantinople, by Sir Thomas Rowe, ambassador from England to the Grand Signior, about the year 1628. Cyrillus brought it with him from Alexandria, where probably it was written. In a schedule annexed to it, he gives this account: That it was written, as tradition informed them, by Thecla, a noble Egyptian lady, about 1300 years ago, not long after the council of Nice. But this high antiquity, and the authority of the tradition, to which the patriarch refers, have been disputed; nor are the most accurate Biblical writers agreed about its age. Grabe thinks that it might have been written before the end of the fourth century; others are of opinion, that it was not written till near the end of the fifth century, or somewhat later.

Alexandrian, or *Alexandrine*, in *Poetry*, a kind of verse consisting of twelve, or of twelve and thirteen syllables alternately; so called from a poem on the life of Alexander written in this kind of verse by some French poet. Alexandrines are peculiar to modern poetry, and seem well adapted to epic poems. They are sometimes used by most nations of Europe; but chiefly by the French, whose tragedies are generally composed of Alexandrines.

ALEXICACUS, something that preserves the body from harm or mischief. The word amounts to much the same as *alexiterial*.

Alexicacus, in *Antiquity*, was an attribute of Neptune, whom the tunny-fishers used to invoke under this appellation, that their nets might be preserved from the ξιφιας, or sword-fish, which used to tear them; and that he might prevent the assistance which it was pretended the dolphins used to give the tunnies on this occasion.

Alexipharmics || Alfet.

ALEXIPHARMICS, in *Medicine*, are properly remedies for expelling or preventing the ill effects of poison: but some of the moderns having imagined that the animal spirits in acute distempers were affected by a malignant poison, the term has been understood to mean medicines adapted to expel this poison by the cutaneous pores, in the form of sweat. In this sense, alexipharmics are the same as sudorifics.

ALEXIS, a Piedmontese. There is a book of "Secrets," which for a long time has gone under his name. It was printed at Basil 1536, in 8vo, and translated from Italian into Latin by Wecher; it has also been translated into French, and printed several times with additions. There is a preface to the piece, wherein Alexis informs us, that he was born of a noble family; that he had from his most early years applied himself to study; that he had learned the Greek, the Latin, the Hebrew, the Chaldean, the Arabian, and several other languages; that having an extreme curiosity to be acquainted with the secrets of nature, he had collected as much as he could during his travels for 57 years; that he picqued himself upon not communicating his secrets to any person; but that when he was 82 years of age, having seen a poor man who had died of a sickness which might have been cured had he communicated his secret to the surgeon who took care of him, he was touched with such a remorse of conscience, that he lived almost like a hermit: and it was in this solitude that he arranged his secrets in such order as to make them fit to be published. The hawkers generally carry them, with other books, to the country fairs. These, however, contain only the select remedies of Seignior Alexis of Piedmont; the entire collection would make too large a volume for them.

ALEXITERIAL, among *Physicians*, a term of much the same import with *alexipharmic*; though sometimes used in a synonymous sense with amulet.

ALEYN, Charles, an English poet in the reign of Charles I. In 1631, he published two poems, entitled, "The Battailes of Cressey and Poictiers, under the fortunes and valour of King Edward of that name, and his sonne Edward prince of Wales, named *the Black*." He succeeded his father as clerk of the ordnance, and was commissary-general of the artillery to the king at the battle of Edgehill. The next piece he wrote was a poem in honour of Henry VII. and the victory that gained him the crown of England. In 1639, the year before he died, he translated the history of Eurialis and Lucretia, from the Latin epistles of Æneas Sylvius.

ALFANDIGA, the name of the customhouse at Lisbon.

ALFAQUES, among *the Moors*, the name generally used for their clergy, or those who teach the Mahometan religion; in opposition to the Morabites, who answer to monks among Christians.

ALFATERNA, in *Ancient Geography*, the last town of Campania, beyond Vesuvius (Diodorus); the same with Nocera, which see. The inhabitants *Alfaterni* (Pliny).

ALFDOUCH, a name given by the Moors to a sort of vermicelli, which they make of flour and water, and are very fond of in their entertainments.

ALFET, in our *Old Customs*, denotes a caldron full

Alford, Alfred.

full of boiling water, wherein an accuſed perſon, by way of trial or purgation, plunged his arm up to the elbow.

ALFORD, a town of Lincolnſhire, ſituated on a ſmall brook that runs through the town. A ſalt ſpring was diſcovered here in 1670, from the pigeons which flew thither in great numbers to drink the water; thoſe birds being known to be fond of ſalt. It contains a ſtrong purging ſalt, together with a portion of ſea-ſalt. It is recommended as cooling, cleanſing, and attenuating, as a good remedy in the ſcurvy, jaundice, and other glandular obſtructions. It alſo promotes urine and ſweat, and therefore is good in gravelly and other diſorders of the kidneys and bladder. Alford is ſix miles from the ſea, and 20 north of Boſton. E. Long. 0. 15. N. Lat. 53. 30.

ALFRED, or ÆLFRED, the Great, king of England, was the fifth and youngeſt ſon of Æthelwolf king of the Weſt Saxons, and was born at Wantage in Berkſhire in 849. He diſtinguiſhed himſelf, during the reign of his brother Ethelred, in ſeveral engagements againſt the Danes; and upon his death ſucceeded to the crown, in the year 871, and the 22d of his age. At his aſcending the throne, he found himſelf involved in a dangerous war with the Danes, and placed in ſuch circumſtances of diſtreſs as called for the greateſt valour, reſolution, and all the other virtues with which he was adorned. The Danes had already penetrated into the heart of his kingdom; and before he had been a month upon the throne, he was obliged to take the field againſt thoſe formidable enemies. After many battles gained on both ſides, he was at length reduced to the greateſt diſtreſs, and was entirely abandoned by his ſubjects. In this ſituation, Alfred, conceiving himſelf no longer a king, laid aſide all marks of royalty, and took ſhelter in the houſe of one who kept his cattle. He retired afterwards to the iſle of Æthelingey in Somerſetſhire, where he built a fort for the ſecurity of himſelf, his family, and the few faithful ſervants who repaired thither to him. When he had been about a year in this retreat, having been informed that ſome of his ſubjects had routed a great army of the Danes, killed their chiefs, and taken their magical ſtandard (A), he iſſued his letters, giving notice where he was, and inviting his nobility to come and conſult with him. Before they came to a final determination, Alfred, putting on the habit of a harper, went into the enemy's camp, where, without ſuſpicion, he was everywhere admitted, and had the honour to play before their princes. Having thereby acquired an exact knowledge of their ſituation, he returned in great ſecrecy to his nobility, whom he ordered to their reſpective homes, there to draw together each man as great a force as he could; and upon a day appointed there was to be a general rendezvous at the great wood called *Selwood*, in Wiltſhire. This affair was tranſacted ſo ſecretly and expeditiouſly, that, in a little time, the king, at the head of an army, approached the Danes, before they had the leaſt intelligence of his deſign. Alfred, taking advantage of the ſurpriſe and terror they were in, fell upon them, and totally defeated them at Æthendune, now Eddington. Thoſe who eſcaped fled to a neighbouring caſtle, where they were ſoon beſieged, and obliged to ſurrender at diſcretion. Alfred granted them better terms than they could expect. He agreed to give up the whole kingdom of the Eaſt-Angles to ſuch as would embrace the Chriſtian religion, on condition they would oblige the reſt of their countrymen to quit the iſland, and, as much as it was in their power, prevent the landing of any more foreigners. For the performance thereof he took hoſtages; and when, in purſuance of the treaty, Guthrum the Daniſh captain came, with 30 of his chief officers, to be baptized, Alfred anſwered for him at the font, and gave him the name of *Æthelſtane;* and certain laws were drawn up betwixt the king and Guthrum for the regulation and government of the Danes ſettled in England. In 884, a freſh number of Danes landed in Kent, and laid ſiege to Rocheſter; but the king coming to the relief of that city, they were obliged to abandon their deſign. Alfred had now great ſucceſs; which was chiefly owing to his fleet, an advantage of his own creating. Having ſecured the ſea-coaſts, he fortified the reſt of the kingdom with caſtles and walled towns; and he beſieged and recovered from the Danes the city of London, which he reſolved to repair, and to keep as a frontier (B).

Alfred.

After ſome years reſpite, Alfred was again called into the field: for a body of Danes, being worſted in the weſt of France, came with a fleet of 250 ſail on the coaſt of Kent; and having landed, fixed themſelves at Apple-tree: ſhortly after, another fleet of 80 veſſels coming up the Thames, the men landed, and built a fort at Middleton. Before Alfred marched againſt the enemy,

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(A) "This (ſays Sir John Spelman) was a banner, with the image of a raven magically wrought by the three ſiſters of Hinguar and Hubba, on purpoſe for their expedition, in revenge of their father Lodebroch's murder, made, they ſay, almoſt in an inſtant, being by them at once begun and finiſhed in a noontide, and believed by the Danes to have carried great fatality with it, for which it was highly eſteemed by them. It is pretended, that, being carried in battle, towards good ſucceſs it would always ſeem to clap its wings, and make as if it would fly; but towards the approach of miſhap, it would hang down and not move." (*Life of Alfred*, p. 61.)

(B) The Danes had poſſeſſed themſelves of London in the time of his father; and had held it till now as a convenient place for them to land at, and fortify themſelves in; neither was it taken from them but by a cloſe ſiege. However, when it came into the king's hands, it was in a miſerable condition, ſcarce habitable, and all its fortifications ruined. The king, moved by the importance of the place, and the deſire of ſtrengthening his frontier againſt the Danes, reſtored it to its ancient ſplendour. And obſerving, that through the confuſion of the times, many, both Saxons and Danes, lived in a looſe diſorderly manner, without owning any government, he offered them now a comfortable eſtabliſhment, if they would ſubmit and become his ſubjects. This propoſition was better received than he expected; for multitudes growing weary of a vagabond kind of life, joyfully accepted ſuch an offer. (*Chron. Sax.* p. 88.)

Alfred.

enemy, he obliged the Danes, settled in Northumberland and Essex, to give him hostages for their good behaviour. He then moved towards the invaders, and pitched his camp between their armies, to prevent their junction. A great body, however, moved off to Essex; and crossing the river, came to Farnham in Surry, where they were defeated by the king's forces. Mean while the Danes settled in Northumberland, in breach of treaty, and notwithstanding the hostages given, equipped two fleets; and, after plundering the northern and southern coasts, sailed to Exeter, and besieged it. The king, as soon as he received intelligence, marched against them; but before he reached Exeter, they had got possession of it. He kept them, however, blocked up on all sides; and reduced them at last to such extremities, that they were obliged to eat their horses, and were even ready to devour each other. Being at length rendered desperate, they made a general sally on the besiegers; but were defeated, though with great loss on the king's side. The remainder of this body of Danes fled into Essex, to the fort they had built there, and to their ships. Before Alfred had time to recruit himself, another Danish leader, whose name was Laf, came with a great army out of Northumberland, and destroyed all before him, marching on to the city of Werheal in the west, which is supposed to be Chester, where they remained the rest of that year. The year following they invaded North-Wales; and after having plundered and destroyed every thing, they divided, one body returning to Northumberland, another into the territories of the East-Angles; from whence they proceeded to Essex, and took possession of a small island called *Meresig*. Here they did not long remain; for having separated, some sailed up the river Thames, and others up the Lea-road; where drawing up their ships, they built a fort not far from London, which proved a great check upon the citizens, who went in a body and attacked it, but were repulsed with great loss: at harvest time the king himself was obliged to encamp with a body of troops in the neighbourhood of the city, in order to cover the reapers from the excursions of the Danes. As he was one day riding by the side of the river Lea, after some observations he began to think that the Danish ships might be laid quite dry: this he attempted, and succeeded; so that the Danes deserted their fort and ships, and marched away to the banks of the Severn, where they built a fort, and wintered at a place called *Quatbrig* (c). Such of the Danish ships as could be got off, the Londoners carried into their own road; the rest they burnt and destroyed.

Alfred enjoyed a profound peace during the three last years of his reign, which he chiefly employed in establishing and regulating his government, for the security of himself and his successors, as well as the ease and benefit of his subjects in general. After a troublesome reign of 28 years, he died on the 28th of October A. D. 900; and was buried at Winchester, in Hyde-abbey, under a monument of porphyry.

All our historians agree in distinguishing him as one of the most valiant, wisest, and best of kings that ever reigned in England; and it is also generally allowed, that he not only digested several particular laws still in being, but that he laid the first foundation of our present happy constitution. There is great reason to believe that we are indebted to this prince for trials by juries; and the Doomsday book, which is preserved in the exchequer, is thought to be no more than another edition of Alfred's book of Winchester, which contained a survey of the kingdom. It is said also, that he was the first who divided the kingdom into shires. What is ascribed to him is not a bare division of the country, but the settling a new form of judicature; for after having divided his dominions into shires, he subdivided each shire into three parts, called *trythings*. There are some remains of this ancient division in the ridings of Yorkshire, the laths of Kent, and the three parts of Lincolnshire. Each trything was divided into hundreds or wapentakes; and these again into tythings or dwellings of ten householders: each of these householders stood engaged to the king, as a pledge for the good behaviour of his family, and all the ten were mutually pledges for each other; so that if any one of the tythings was suspected of an offence, if the head boroughs or chiefs of the tythings would not be security for him, he was imprisoned; and, if he made his escape, the tything and hundred were fined to the king. Each shire was under the government of an earl, under whom was the reive, his deputy; since, from his office, called *shire-reive*, or *sheriff*. And so effectual were these regulations, that it is said he caused bracelets of gold to be hung up in the highways, as a challenge to robbers; and they remained untouched.

In private life, Alfred was the most amiable man in his dominions; of so equal a temper, that he never suffered either sadness or unbecoming gaiety to enter his mind; but appeared always of a calm, yet cheerful disposition, familiar to his friends, just even to his enemies, kind and tender to all. He was a remarkable economist of his time; and Asserius has given us an account of the method he took for dividing and keeping an account of it: he caused six wax-candles to be made, each of 12 inches long, and of as many ounces weight; on the candles the inches were regularly marked, and having found that one of them burnt just four hours, he committed them to the care of the keepers of his chapel, who from time to time gave him notice how the hours went: but as in windy weather the candles were wasted by the impression of the air on the flame, to remedy this inconvenience, he invented lanthorns, there being then no glass in his dominions.

This prince, we are told, was 12 years of age before a master could be procured in the western kingdom to

(c) The king's contrivance is thought to have produced the meadow between Hertford and Bow; for at Hertford was the Danish fort, and from thence they made frequent excursions on the inhabitants of London. Authors are not agreed as to the method the king pursued in laying dry the Danish ships: Dugdale supposes that he did it by straitening the channels; but Henry of Huntingdon alleges, that he cut several canals, which exhausted its water.

to teach him the alphabet; ſuch was the ſtate of learning when Alfred began to reign. He had felt the miſery of ignorance; and determined even to rival his cotemporary Charlemagne in the encouragement of literature. He is ſuppoſed to have appointed perſons to read lectures at Oxford, and is thence conſidered as the founder of that univerſity. By other proper eſtabliſhments, and by a general encouragement to men of abilities, he did every thing in his power to diffuſe knowledge throughout his dominions. Nor was this end promoted more by his countenance and encouragement than by his own example and his writings. For notwithſtanding the lateneſs of his initiation, he had acquired extraordinary erudition; and, had he not been illuſtrious as a king, he would have been famous as an author. His works are, 1. *Breviarium quoddam collectum ex Legibus Trojanorum*, &c. Lib. i. A Breviary collected out of the laws of the Trojans, Greeks, Britons, Saxons, and Danes, in one book. Leland ſaw this book in the Saxon tongue, at Chriſt-church in Hampſhire. 2. *Viſi-Saxonum Leges*, Lib. i. The laws of the Weſt-Saxons, in one book. Pitts tells us, that it is in Bennet-College library, at Cambridge. 3. *Inſtituta quædam*, lib. i. Certain Inſtitutes, in one book. This is mentioned by Pitts, and ſeems to be the ſecond capitulation with Guthrum. 4. *Contra Judices iniquos*, lib. i. An invective againſt Unjuſt Judges, in one book. 5. *Acta Magiſtratuum ſuorum*, lib. i. Acts of his Magiſtrates, in one book. This is ſuppoſed to be the Book of Judgments mentioned by Horne; and was, in all probability, a kind of reports, intended for the uſe of ſucceeding ages. 6. *Regum fortunæ variæ*, lib. i. The various Fortunes of Kings, in one book. 7. *Dicta Sapientum*, lib. i. The ſayings of Wiſe Men, in one book. 8. *Parabolæ et Sales*, lib. i. Parables and pleaſant Sayings, in one book. 9. *Collectiones Chronicorum*, Collection of Chronicles. 10. *Epiſtolæ ad Wulfsigium Epiſcopum*, lib. i. Epiſtles to Biſhop Wulfsig, in one book. 11. *Manuale Meditationum.* A Manual of Meditations.—Beſides thoſe original works, he tranſlated many authors from the Latin, &c. into the Saxon language, viz. 1. Bede's Hiſtory of England. 2. Paulinus Oroſinus's Hiſtory of the Pagans. 3. St Gregory's Paſtoral, &c. The firſt of theſe, with his prefaces to the others, together with his laws, were printed at Cambridge, 1644. His laws are likewiſe inſerted in Spelman's Councils. 4. *Boethius de Conſolatione*, lib. v. Boetius's Conſolations of Philoſophy, in five books. Dr Plot tells us, King Alfred tranſlated it at Woodſtock, as he found in a MS. in the Cotton Library. 5. *Æſopi Fabulæ*, Æſop's Fables: which he is ſaid to have tranſlated from the Greek both into Latin and Saxon. 6. *Pſalterium Davidicum*, lib. i. David's Pſalter, in one book. This was the laſt work the king attempted, death ſurpriſing him before he had finiſhed it; it was, however, completed by another hand, and publiſhed at London in 1640, in quarto, by Sir John Spelman. Several others are mentioned by Malmſbury; and the old hiſtory of Ely aſſerts, that he tranſlated the Old and New Teſtaments.

The life of this great king was firſt written by Aſſerius Menevenſis; and firſt publiſhed by Archbiſhop Parker, in the old Saxon character, at the end of his edition of Haſſingham's hiſtory, printed in 1674, fol.

ALGA, in *Botany*, the trivial name of the lichen, fucus, and ſeveral other plants of the cryptogamia claſs.

ALGÆ, FLAGS; one of the ſeven families or natural tribes into which the whole vegetable kingdom is divided by Linnæus, in his *Philoſophia Botanica.* They are defined to be plants, whoſe root, leaf, and ſtem, are all one. Under this deſcription are comprehended all the ſea-weeds, and ſome other aquatic plants. In the ſexual ſyſtem, they conſtitute the 3d order of the 24th claſs, *Cryptogamia;* in Tournefort, the ſecond genus of the ſecond ſection, *Marinæ, aut fluviatiles*, of the 17th claſs, *Aſpermæ vulgo habitæ;* and the 57th order in Linnæus's Fragments of a Natural Method. The diſcoveries made in this part of the vegetable kingdom are uncertain, and imperfect; and the attempts, in particular, to arrange flags by the parts of the fructification, have not been attended with great ſucceſs. Dillenius has arranged this order of plants from their general habit and ſtructure; Michelius from the parts of fructification.

ALGAGIOLA, a ſmall ſea-port town in the iſland of Corſica, fortified with walls and baſtions. It was almoſt deſtroyed by the malecontents in 1731, but has ſince been repaired. E. Long. 9. 45. N. Lat. 42. 20.

ALGAROTH, in *Chemiſtry*, is a white oxyde of antimony, which is obtained by waſhing the butter or oxymuriate with pure water. See CHEMISTRY *Index*.

ALGAROTTI, COUNT, a celebrated Italian, was born at Padua; but the year is not mentioned. Led by curioſity, as well as a deſire of improvement, he travelled early into foreign countries; and was very young when he arrived in France in 1736. Here he compoſed his "Newtonian Philoſophy for the Ladies;" as Fontenelle had done his Carteſian Aſtronomy, in the work entitled "The Plurality of worlds." He was noticed by the king of Pruſſia, who gave him marks of the eſteem he had for him. He died at Piſa the 23d of May 1764; and ordered his own mauſoleum, with this inſcription to be fixed upon it: "*Hic jacet Algarottus, ſed non omnis.*" He is allowed to have been a very great connoiſſeur in painting, ſculpture, and architecture. He contributed much to the reformation of the Italian opera. His works, which are numerous, and upon a variety of ſubjects, abound with vivacity, elegance, and wit: a collection of them has lately been made, and printed at Leghorn in 1765, in 4 vols. 8vo.

ALGARVA, a province in the kingdom of Portugal, 67 miles in length and 20 in breadth; bounded on the weſt and ſouth by the ſea, on the eaſt by the river Guadiana, and on the north by Alentejo. It is very fertile in figs, almonds, dates, olives, and excellent wines; and, beſides, has a very abundant and lucrative fiſhery. The capital town is Pharo. It contains four cities, 12 towns, 67 pariſhes, and it is ſaid, above 90,000 inhabitants.

ALGEBRA.

INTRODUCTION.

History.

1. ALGEBRA is a general method of reasoning, concerning the relations which magnitudes of every kind bear to each other in respect of quantity. It is sometimes called *universal arithmetic*; its first principles and operations being similar to those of common arithmetic. The symbols which it employs to denote magnitudes are, however, more general and more extensive in their application than those employed in that science; hence, and from the great facility with which the various relations of magnitudes to one another may be expressed, by means of a few signs or characters; the application of algebra to the resolution of problems is much more extensive than that of common arithmetic.

2. There are various opinions as to the etymology of the name *algebra*. It is pretty certain, however, that the word is Arabic, and that from the Arabians the name, as well as the art itself, is derived. Lucas de Burgo, the first European author whose treatise on algebra was printed, calls it by the Arabic name *Alghebra e Almucabala*, which is explained to denote the art of *restitution* and *comparison*, or *opposition* and *comparison*, or *resolution* and *equation*, all which agree well enough with the nature of this art. Besides this etymology of the name *algebra*, several others have been imagined; that, however, which we have just now given seems to be the most probable of any hitherto assigned.

3. The origin of algebra, as well as that of most other branches of mathematical science, is involved in obscurity; there are indeed traces of it to be found in the works of some of the earliest philosophers and mathematicians, the subject of whose writings must necessarily have led them to the discovery; and, in some measure, to the application of this science.

4. The oldest treatise of algebra, which has come down to the present times, was written by Diophantus of Alexandria, who flourished about the year 350 after Christ, and who wrote 13 books on algebra or arithmetic in the Greek language; though only six of these have hitherto been printed, and one book, which is imperfect, on multangular numbers. It was not, however, from this author, but from the Moors or Arabians, that this, as well as most other sciences, was received in Europe; and some writers are of opinion, that they again received it from the Greeks, while others suppose that they had it from the Persians; and that these last derived algebra, as well as the arithmetical method of computing by ten characters or digits, from the Indians.

5. The Arabians themselves say, that it was invented by Mahomet ben Musa or son of Moses, who it seems flourished about the 8th or 9th century. It seems more probable that Mahomet was not the inventor, but only a person well skilled in the art; and that the Arabians received their knowledge of it from Diophantus, or other Greek writers, as they did that of geometry and some other sciences, which they improved and translated into their own language.

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6. However this may be, it seems to be pretty certain, that the science was first brought to Europe about the beginning of the 15th century, by Leonardus Pisanus, who travelled into Arabia and other eastern countries for the purpose of acquiring mathematical knowledge; and, in a short time, it began to be cultivated in Italy, where it was called *l' Arte Magiore*, "the greater art," to distinguish it from common arithmetic, which was called *l' Arte Minore*, "the lesser art." It was also known in that country by the name *Regola de la Cosa*, or "rule of the thing," where by *Cosa*, or *the thing*, was meant the first, or simple power of the unknown quantity.

7. Between the years 1470 and 1487 Lucas Paciolus or Lucas de Burgo, a Cordelier, or Minorite friar, published several treatises on arithmetic, algebra, and geometry; and, in 1494, his principal work, entitled *Summa de Arithmetica Proportioni et Proportionalita* was printed. The part of this work, which relates to algebra, and which he calls *l' Arte Magiore; ditta dal vulgo la Regola de la Cosa over Alghebra e Almucabala*, may be considered as exhibiting a pretty accurate state of the science, as it was then known in Europe; and probably it was much the same in Africa and Asia, from whence the Europeans derived the knowledge of it. It appears from this work, that their knowledge extended no farther than quadratic equations, of which they used only the positive roots; that they used only one unknown quantity; that they used no marks nor signs for either quantities or operations, excepting a few abbreviations of the words or names themselves; and that the art was only employed in the resolution of certain numeral problems. So that either the Africans had not carried algebra beyond quadratic equations; or else (what indeed is not improbable) the Europeans had not learned the whole of the art, as it was then known to the former.

8. After the publication of the books of Lucas de Burgo, algebra became more generally known and improved, especially in Italy; for about the year 1505, Scipio Ferreus who was then professor of mathematics at Bononia, found out a rule for resolving one case of a compound cubic equation; but, as appears to have been the custom of the times with respect to such matters, he kept the rule a profound secret from his contemporaries. The same thing was afterwards discovered in 1535 by Nicolas Tartalea, who then resided in Venice, and who had five years before found the resolution of two other cases of cubic equations.

9. The next work upon algebra which was printed after the books of Lucas de Burgo, was written by Hieronymus Cardan, of Bononia, a very learned man, who published in 1539 his arithmetical writings, in nine books, at Milan, where he practised physic, and read public lectures on mathematics. The same author in 1545 published a tenth book, containing the whole doctrine of cubic equations, which had been in part communicated to him under an oath of secrecy

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by Tartalea, but which, notwithstanding this circumstance, Cardan thought proper to publish, alleging (not altogether without reason) that he had made so many additions to Tartalea's discovery as to render it in a manner his own. Accordingly we find, that even to the present times, the common rule for resolving cubic equations is generally known by the name of Cardan's rule, although it would certainly be more just to attribute it to its first inventor, Tartalea.

10. Equations of the fourth order appear to have been first resolved by Lewis Ferrari, a disciple of Cardan's; and different methods of resolution were afterwards given by Descartes and others. This indeed is the greatest length that mathematicians have been able to carry the resolution of equations; for, with respect to those of the fifth, and all higher degrees, all attempts to resolve them, except in particular cases, have hitherto been found impracticable.

11. After this period, writers on algebra became more numerous; and many improvements were gradually made, both in the notation and in the theory of the science. Among other writers who cultivated it with success may be reckoned Bombelli, another Italian mathematician; Stifelius and Scheubelius, both of Germany; Robert Recorde, an English mathematician; and many others.

12. Among the mathematicians to whom algebra is particularly indebted, it is proper to mention Francis Vieta, a native of France, who wrote about the year 1600. Among various improvements in all parts of the science, he first introduced the general use of the letters of the alphabet, to denote indefinite given quantities, which, before his time, had only been done in some particular cases. The English mathematician, Harriot, deserves also to be particularly mentioned. His algebra, which was published after his death, in 1631, shews that he cultivated that science with great success. For, besides improving the notation, so as to render it nearly the same as it is at present, he first explained clearly a most important proposition in the theory of equations, namely, that an equation of any degree may be considered as produced by the continual multiplication of as many simple equations as there are units in the exponent of the highest power of the unknown quantity in that equation: Hence he shewed the relation which subsists between the coefficients of the terms of an equation and its roots.

13. Without mentioning all the writers on algebra who flourished about this time, and who severally contributed more or less to its improvement, we proceed to observe, that nothing has contributed more to the advancement of every branch of mathematical knowledge than the happy application which the celebrated philosopher Descartes made of algebra to the science of geometry; for his geometry, first published in 1637, may be considered rather as the application of algebra to geometry than as either algebra or geometry taken by itself as a science. Besides this happy union effected between the two sciences, Descartes contributed much to the improvement of both; and indeed he may be considered as having paved the way for all the discoveries which have since been made in mathematics.

14. After the publication of Descartes' Geometry, the science of algebra may be considered as having attained some degree of perfection. It has, however, received many improvements from later writers, who, pursuing the paths struck out by Harriot and Descartes, have produced many new and beautiful theories, both in algebra and geometry. The writers upon algebra from this time became too numerous, and the respective improvements made by each too minute, to be particularly noticed in this introduction. It is, however, necessary to mention another mathematician, to whom algebra lies under considerable obligations, namely, M. Fermat, who may be considered as the rival of Descartes; for it appears that he was in possession of the method of applying algebra to the improvement of geometry before the publication of the celebrated work of the latter philosopher. Besides, Fermat appears to have been deeply versed in the theory of indeterminate problems; and he republished the oldest and most esteemed treatise upon that subject which is known, namely, Diophantus's Arithmetic, to which he added many valuable notes of his own.

Notation.

15. Having now given a brief account of the origin of algebra, and of the writers who contributed the most to bring it to the state of perfection it had attained about the middle of the 16th century, which indeed was considerable, we shall conclude this introduction, by observing, that although its progress has since been very gradual, it has been upon the whole considerably improved; particularly by the labours of these foreign mathematicians, Schooten, Hudde, Van-Heuraet, De Witte, Slusius, Huygens, &c. As to the algebraical writers of our own country, those whose labours have been most conspicuous were Wallis, and more especially Sir I. Newton, to whom, among other things, we owe the invention of the binomial theorem: also Pell, Barrow, Kersey, Halley, Raphson, and many others. We now proceed to explain the science itself.

Notation and Explanation of the Signs.

16. In arithmetic there are ten characters, which being variously combined, according to certain rules, serve to denote all magnitudes whatever. But this method of expressing quantities, although of the greatest utility in every branch of the mathematics, (for we must always have recourse to it in the different applications of that science to practical purposes) is yet found to be inadequate, taken by itself, to the more difficult cases of mathematical investigation; and it is therefore necessary in many inquiries concerning the relations of magnitude, to have recourse to that more general mode of notation, and more extensive system of operations, which constitute the science of algebra.

17. In algebra quantities of every kind may be denoted by any characters whatever, but those commonly used are the letters of the alphabet: And as in every mathematical problem, there are certain magnitudes given, in order to determine other magnitudes, which are unknown, the first letters of the alphabet, a, b, c, &c. are used to denote known quantities, while these to be found are represented by v, x, y, &c. the last letters of the alphabet.

18. The sign + (*plus*) denotes that the quantity before which it is placed is to be added to some other quantity. Thus $a+b$ denotes the sum of a and b; $3+5$ denotes the sum of 3 and 5, or 8.

19. The sign — (*minus*) signifies that the quantity before

 before which it is placed is to be subtracted. Thus $a-b$ denotes the excess of a above b; $6-2$ is the excess of 6 above 2, or 4.

20. Quantities which have the sign + prefixed to them are called *positive* or *affirmative;* and such as have the sign — are called *negative*.

When quantities are considered abstractedly, the terms *positive* and *negative* can only mean that such quantities are to be added or subtracted; for as it is impossible to conceive a number less than 0, it follows, that a negative quantity by itself is unintelligible. But, in considering the affections of magnitude, it appears, that in many cases, a certain opposition may exist in the nature of quantities. Thus, a person's property may be considered as a positive quantity, and his debts as a negative quantity. Again, any portion of a line drawn to the right hand may be considered as positive, while a portion of the same line, continued in the opposite direction, may be taken as negative.

When no sign is prefixed to a quantity, + is always understood, or the quantity is to be considered as positive.

21. Quantities which have the same sign, either + or —, are said to have like signs. Thus, $+a$ and $+b$ have like signs, but $+a$, and $-c$ have unlike signs.

22. A quantity which consists of one *term*, is said to be *simple;* but if it consist of several terms, connected by the signs + or —, it is then said to be compound. Thus $+a$ and $-c$ are simple quantities; and $b+c$, also $a+b-d$ are compound quantities.

23. To denote the product arising from the multiplication of quantities; if they be simple, they are either joined together, as if intended to form a word, or else the quantities are connected together, with the sign × interposed between every two of them. Thus ab, or $a\times b$, denotes the product of a and b; also abc, or $a\times b\times c$ denotes the product of a, b, and c; the latter method is used when the quantities to be multiplied are numbers. If some of the quantities to be multiplied be compound, each of them has a line drawn over it called a vinculum, and the sign × is interposed between as before. Thus $a\times\overline{c+d}\times\overline{e-f}$ denotes that a is to be considered as one quantity, the sum of c and d as a second, and the difference between e and f as a third; and that these three quantities are to be multiplied into one another. Instead of placing a line over such compound quantities as enter a product, it is now common among mathematical writers to enclose each of them between two parentheses, so that the last product may be otherwise expressed thus, $a(c+d)(e-f)$, or thus, $a\times(c+d)\times(e-f)$.

24. A number prefixed to a letter is called a *numeral coefficient*, and denotes how often that quantity is to be taken. Thus, $3a$ signifies that a is to be taken three times. When no number is prefixed, the coefficient is understood to be unity.

25. The quotient arising from the division of one quantity by another is expressed by placing the *dividend* above a line, and the *divisor* below it. Thus $\frac{12}{3}$ denotes the quotient arising from the division of 12 by 3 or 4; $\frac{b}{a}$ denotes the quotient arising from the division of b by a. This expression of a quotient is also called a fraction.

26. The equality of two quantities is expressed by putting the sign = between them. Thus $a+b=c-d$ denotes that the sum of a and b is equal to the excess of c above d.

27. Simple quantities, or the terms of compound quantities, are said to be *like*, which consist of the same letter or letters. Thus $+ab$ and $-5ab$ are like quantities; but $+ab$ and $+abb$ are unlike.

There are some other characters which will be explained when we have occasion to use them; and in what follows we shall suppose that the operations of common arithmetic are sufficiently understood; for algebra, being an extension of that science, ought not to be embarrassed by the demonstration of its elementary rules.

Sect. I. *Fundamental Operations.*

28. The primary operations in algebra are the same as in common arithmetic, namely, addition, subtraction, multiplication, and division; and from the various combinations of these four, all the others are derived.

Problem I. *To Add Quantities.*

29. In addition there may be three cases: the quantities to be added may be like, and have like signs; or, they may be like, and have unlike signs; or, lastly, they may be unlike.

Case 1. To add quantities which are like, and have like signs.

Rule. Add together the coefficients of the quantities, prefix the common sign to the sum, and annex the letter, or letters, common to each term.

Examples.

$$\text{Add together}\left\{\begin{array}{r}+7a\\+3a\\+a\\+2a\end{array}\right. \qquad \text{Add together}\left\{\begin{array}{r}-2ax\\-ax\\-5ax\\-12ax\end{array}\right.$$

$$\text{Sum,}\ +13a \qquad\qquad \text{Sum,}\ -20ax$$

Case 2. To add quantities which are like, but have unlike signs.

Rule. Add the positive coefficients into one sum, and the negative ones into an other; then subtract the least of these sums from the greatest, prefix the sign of the greatest to the remainder, and annex the common letter, or letters, as before.

Examples.

$$\text{Add together}\left\{\begin{array}{r}+2ax\\-ax\\-3ax\\+9ax\end{array}\right. \qquad \text{Add together}\left\{\begin{array}{r}+6ab+7\\-4ab+9\\+ab-5\\+7ab-13\end{array}\right.$$

$$\begin{array}{lr}\text{Sum of the pos.} & +11ax\\ \text{Sum of the neg.} & -4ax\\ \hline \text{Sum required,} & +7ax\end{array} \qquad \begin{array}{lr}\text{Sum of the pos.} & +14ab+16\\ \text{Sum of the neg.} & -4ab-18\\ \hline \text{Sum required,} & +10ab-2\end{array}$$

Subtraction.

$$\begin{array}{lll} aa+2ax-xx & & -4aab \\ -2aa+3ax-4xx & & +aab \\ 6aa-5ax+11xx & & +3aab \\ \hline \text{Sum, } 5aa\quad 0\ +\ 6xx & & \text{Sum, }\quad 0 \end{array}$$

Case 3. To add unlike quantities.

Rule. Put down the quantities, one after another, in any order, with their signs and coefficients prefixed.

EXAMPLES.

$$\begin{array}{lll} 2a & & ax+2ay \\ 3b & & bb-3bz \\ -4c & & \\ \hline \text{Sum, } 2a+3b-4c & & \text{Sum, } ax+2ay+bb-3bz \end{array}$$

PROB. II. *To Subtract Quantities.*

30. *General Rule.* Change the signs of the quantities to be subtracted, or suppose them changed, and then add them to the other quantities, agreeably to the rules of addition.

EXAMPLES.

$$\begin{array}{lll} \text{From } 5a-12b & & \text{From } 6x-8y+3 \\ \text{Subtract } 2a-5b & & \text{Subtract } 2x+9y-2 \\ \hline \text{Remainder } 3a-7b & & \text{Remainder } 4x-17y+5 \end{array}$$

$$\begin{array}{lll} 5xy-2+8x-y & & aa-ax-yy \\ 3xy-8-8x-3y & & bb-by+zz \\ \hline 2xy+6+16x+2y & & aa-ax-yy-bb+by-zz \end{array}$$

31. The reason of the rule for subtraction may be explained thus. Let it be required to subtract $2p-3q$ from $m+n$. If we subtract $2p$ from $m+n$ there will remain $m+n-2p$; but if we are to subtract $2p-3q$, which is less than $2p$, it is evident that the remainder will be greater by a quantity equal to $3q$; that is, the remainder will be $m+n-2p+3q$; hence the reason of the rule is evident.

PROB. III. *To Multiply Quantities.*

32. *General Rule for the Signs.* If the quantities to be multiplied have like signs, the sign of the product is +; but if they have unlike signs, the sign of the product is —.

33. The examples of multiplication may be referred to two cases; the first is when both the quantities are simple; and the second when one or both of them are compound.

Case I. To multiply simple quantities.

Rule. Find the sign of the product by the general rule, and annex to it the product of the numeral coefficients, then set down all the letters, one after another, as in one word.

EXAMPLES.

$$\begin{array}{llll} \text{Multiply} & +a & +5b & -3ax \\ \text{By} & +c & -4a & +7ab \\ \hline \text{Product} & +ac & -20ab & -21aabx \end{array}$$

$$\begin{array}{l} -2ab \\ -3cz \\ \hline +6abcz \end{array}$$

Case II. To multiply compound quantities.

Rule. Multiply every term of the multiplicand by all the terms of the multiplier, one after another, by the preceding rule, and collect their products into one sum, which will be the product required.

Multiplication.

EXAMPLES.

$$\begin{array}{lll} \text{Multiply } 4a-2b+c & & 2x+y \\ \text{By }\qquad 3a & & x-2y \\ \hline \text{Product } 12aa-6ab+3ac & & 2xx+xy \\ & & \quad -4xy-2yy \\ \hline & & 2xx-3xy-2yy \end{array}$$

$$\begin{array}{lll} aa-ab+bb & & a-b+c \\ a+b & & a+b-c \\ \hline aaa-aab+abb & & aa-ab+ac \\ \quad +aab-abb+bbb & & \quad +ab\quad -bb+bc \\ & & \qquad -ac\quad +bc-cc \\ \hline aaa\quad *\quad *+bbb & & aa\quad *\quad *\ -bb+2bc-cc. \end{array}$$

34. The reason of the rules for the multiplication of quantities may be explained in the following manner: Let it be required to multiply $a-b$ by $c-d$; because multiplication is a repeated addition of the multiplicand as often as the multiplier contains unity, therefore, $a-b$ is to be taken as often as there are units in $c-d$, and the sum will be the product required. Now if $a-b$ be taken as often as there are units in c, the result will evidently exceed the product required, and that by a quantity equal to $a-b$, taken as often as there are units in d. But, from the nature of addition $a-b$ taken as often as there are units in c, is $ca-cb$, and for the same reason, $a-b$ taken as often as there are units in d is $da-db$; therefore, to obtain the product required, we must subtract $da-db$ from $ca-cb$: but from what has been shewn in subtraction, the remainder will be $ca-cb-da+db$; therefore the product arising from the multiplication of $a-b$ by $c-d$ is $ca-cb-da+db$; hence the reason of the general rule for the signs, as well as the other rules, is manifest.

35. When several quantities are multiplied together so as to constitute a product, each of them is called a *factor* of that product; thus a, b, and c are factors of the product abc; also $a+x$, and $b-x$ are factors of the product $(a+x)(b-x)$.

36. The products arising from the continual multiplication of the same quantity are called *powers* of that quantity, which is called the *root*. Thus aa, aaa, $aaaa$, &c. are powers of the root a. These powers are commonly expressed, by placing above the root, towards the right hand, a figure, denoting how often the root is repeated. This figure serves to denominate the power, and is called its *index* or *exponent*. Thus, the quantity a being considered as the root, or as the first power of a, we have aa or a^2 for its second power,

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power, aaa or a^3 for its third power, $aaaa$ or a^4 for its fourth power, and ſo on.

37. The ſecond and third powers of a quantity are generally called its *ſquare* and *cube*; and the fourth, fifth, and ſixth powers are ſometimes reſpectively called its *biquadrate*, *ſurſolid*, and *cubocube*.

38. By conſidering the notation of powers, and the rules for multiplication, it appears that powers of the ſame root are multiplied by adding their exponents. Thus $a\times a^3=a^4$, alſo $x^3\times x^4=x^7$; and in general $a^m\times a^n=a^{m+n}$.

Prob. IV. *To Divide Quantities.*

39. *General Rule for the Signs.* If the ſigns of the diviſor and dividend be like, the ſign of the quotient is $+$; but if they be unlike, the ſign of the quotient is $-$.

This rule is eaſily derived from the general rule for the ſigns in multiplication, by conſidering that the quotient muſt be ſuch a quantity as when multiplied by the diviſor ſhall produce the dividend, with its proper ſign.

40. The quotient ariſing from the diviſion of one quantity by another may be expreſſed by placing the dividend above a line and the diviſor below it, (§ 25), but it may alſo be often expreſſed in a more ſimple manner by the following rules:

Caſe 1. When the diviſor is ſimple, and a factor of every term of the dividend.

Rule. Divide the coefficient of each term of the dividend by the coefficient of the diviſor, and expunge out of each term the letter or letters in the diviſor: the reſult is the quotient.

Ex. 1. Divide $12abc$ by $3ac$.

From the method of notation, the quotient may be expreſſed thus $\frac{12abc}{3ac}$; but the ſame quotient, by the rule juſt given, is more ſimply expreſſed thus $4b$.

Ex. 2. Divide $16a^3xy-28a^2xz^2+4a^2x^3$ by $4a^2x$. The quotient is $4ay-7z^2+x^2$.

If the diviſor and dividend be powers of the ſame quantity, the diviſion will evidently be performed by ſubtracting the exponent of the diviſor from that of the dividend. Thus a^5 divided by a^3 has for a quotient $a^{5-3}=a^2$.

Caſe 2. When the diviſor is ſimple, but not a factor of the dividend.

Rule. The quotient is expreſſed by a fraction, of which the numerator is the dividend, and the denominator the diviſor.

Thus the quotient of $3ab^2$ divided by $2mbc$ is the fraction $\frac{3ab^2}{2mbc}$.

It will ſometimes happen, that the quotient found thus may be reduced to a more ſimple form, as ſhall be explained when we come to treat of fractions.

Caſe 3. When the diviſor is compound.

Rule. 1. The terms of the dividend are to be arranged according to the powers of ſome one of its letters, and thoſe of the diviſor according to the powers of the ſame letter.

2. The firſt term of the dividend is to be divided by the firſt term of the diviſor, obſerving the general rule for the ſigns; and this quotient being ſet down for a part of the quotient wanted, is to be multiplied by the whole diviſor, and the product ſubtracted from the dividend. If nothing remain, the diviſion is finiſhed; but if there be a remainder, it is to be taken for a new dividend.

3. The firſt term of the new dividend is next to be divided by the firſt term of the diviſor, as before, and the quotient joined to the part already found, with its proper ſign. The whole diviſor is alſo to be multiplied by this part of the quotient, and the product ſubtracted from the new dividend; and thus the operation is to be carried on till there be no remainder, or till it appear that there will always be a remainder.

To illuſtrate this rule, let it be required to divide $8a^2+2ab-15b^2$ by $2a+3b$; the operation will ſtand thus,

$$\begin{array}{l} 2a+3b)\,8a^2+2ab-15b^2\,(4a-5b \\ \qquad\quad\;\; 8a^2+12ab \\ \hline \qquad\qquad\quad -10ab-15b^2 \\ \qquad\qquad\quad -10ab-15b^2 \\ \hline \end{array}$$

Here the terms of the diviſor and dividend are arranged according to the powers of the quantity a. We now divide $8a^2$, the firſt term of the dividend, by $2a$ the firſt term of the diviſor; and thus get $4a$ for the firſt term of the quotient. We next multiply the diviſor by $4a$, and ſubtract the product $8a^2+12ab$ from the dividend; we thus get $-10ab-15b^2$ for a new dividend.

By proceeding in all reſpects as before, we find $-5b$ for the ſecond term of the quotient, and no remainder; the operation is therefore finiſhed, and the whole quotient is $4a-5b$.

The following examples will alſo ſerve to illuſtrate the manner of applying the rule.

Ex. 1.

$$\begin{array}{l} 3a-b)\,3a^3-12a^2-a^2b+10ab-2b^2\,(a^2-4a+2b \\ \qquad\;\; 3a^3\quad -a^2b \\ \hline \qquad\quad -12a^2\quad +10ab \\ \qquad\quad -12a^2\quad +\;4ab \\ \hline \qquad\qquad\qquad +6ab-2b^2 \\ \qquad\qquad\qquad +6ab-2b^2 \\ \hline \end{array}$$

Ex. 2.

$$\begin{array}{l} a+b)\;a^3+b^3\,(a^2-ab+b^2 \\ \qquad\; a^3+a^2b \\ \hline \qquad\; -a^2b+b^3 \\ \qquad\; -a^2b-ab^2 \\ \hline \qquad\qquad +ab^2-b^3 \\ \qquad\qquad +ab^2-b^3 \\ \hline \end{array}$$

Ex.

Ex. 3.

$$a^3-b^3)a^6-b^6(a^3+b^3$$
$$a^6-a^3b^3$$
$$\overline{\quad+a^3b^3-b^6}$$
$$+a^3b^3-b^6$$

Ex. 4.

$$1-x)1\quad(1+x+x^2+\&c.$$
$$1-x$$
$$\overline{\quad+x}$$
$$+x-x^2$$
$$\overline{\quad+x^2}$$
$$+x^2-x^3$$
$$\overline{\quad+x^3.}$$

41. Sometimes, as in this last example, the quotient will never terminate: in such a case it may either be considered as an infinite series, the law according to which the terms are formed being in general sufficiently obvious; or the quotient may be completed as in arithmetical division, by annexing to it a fraction, the numerator of which is the remainder, and denominator the divisor. Thus the quotient in last example may stand thus $1+x+x^2+\frac{x^3}{1-x}$.

42. The reason of the rule for division is sufficiently manifest. For in the course of the operation, all the terms of the quotient obtained by it are multiplied by all the terms of the divisor, and the products successively subtracted from the dividend, till nothing remain; that therefore must evidently be the true quotient.

Sect. II. *Of Fractions.*

43. In the operation of division, the divisor may be sometimes less than the dividend, or may not be contained in it an exact number of times; in either case the quotient is expressed by means of a fraction. There can be no difficulty, however, in estimating the magnitude of such a quotient; if, for example it were the fraction $\frac{5}{7}$, we may consider it as denoting either that some unit is divided into 7 equal parts, and that 5 of these are taken, or that 5 times the same unit is divided into 7 equal parts, and one of them taken.

44. In any fraction the upper number, or the dividend is called the *numerator*, and the lower number or the divisor is called the *denominator*. Thus in the fraction $\frac{a}{b}$, a is the numerator, and b the denominator.

45. If the numerator be less than the denominator, such a fraction is called a *proper* fraction; but if the numerator be either equal to, or greater than the denominator, it is called an *improper* fraction; and if a quantity be made up of an integer and a fraction, it is called a *mixed* quantity. Thus $\frac{a}{a+x}$ is a proper fraction; $\frac{a}{a}$, also $\frac{a+x}{a}$ are both improper fractions; and $b+\frac{x}{a}$ is a mixed quantity.

46. The *reciprocal* of a fraction is another fraction, having its numerator and denominator respectively equal to the denominator and numerator of the former.

Thus $\frac{b}{a}$ is the reciprocal of the fraction $\frac{a}{b}$.

47. The following proposition is of great importance in the operations relating to fractions.

If the numerator and denominatorof a fraction be either both multiplied, or both divided by the same quantity, the value of that fraction is the same as before.

For let any fraction $\frac{b}{a}=c$; then because c is the quotient arising from the division of b by a, it follows that $b=ac$; and multiplying both by any quantity n, we have $nb=nac$: let these equals be both divided by the same quantity na, and the quotients will be equal, that is $\frac{nb}{na}=c=\frac{b}{a}$; hence the truth of the proposition is manifest.

48. From this proposition, it is obvious that a fraction may be very differently expressed, without changing its value, and that any integer may be reduced to the form of a fraction, by placing the product arising from its multiplication by any assumed quantity as the numerator, and the assumed quantity as the denominator of the fraction. It also appears that a fraction very complex in its form may often be reduced to another of the same value, but more simple, by finding a quantity which will divide both the numerator and denominator, without leaving a remainder. Such a common measure, or common divisor, may be either simple or compound; if it be simple, it is readily found by inspection, but if it be compound, it may be found as in the following problem.

49. Prob. I. *To find the greatest common Measure of two Quantities.*

Rule 1. Range the quantities according to the powers of some one of the letters, as taught in division, leaving out the simple divisors of each quantity.

2. Divide that quantity which is of most dimensions by the other one, and if there be a remainder, divide it by its greatest simple divisor; and then divide the last compound divisor by the resulting quantity, and if any thing yet remains, divide it also by its greatest simple divisor, and the last compound divisor by the resulting quantity: proceed in this way till nothing remain, and the last divisor shall be the common measure required.

Note. It will sometimes be necessary to multiply the dividends by simple quantities in order to make the divisions succeed.

Ex. 1. Required the greatest common measure of the quantities a^2x-x^3 and $a^3-2a^2x+ax^2$. The simple divisor x being taken out of the former of these quantities, and a out of the latter, they are reduced to a^2-x^2, and $a^2-2ax+x^2$, and as the quantity a rises to the same dimensions in both, we may take either of them as the first divisor; let us take that which consists of fewest terms, and the operation will stand thus:

a^2-

Fractions.

$$a^2-x^2)a^2-2ax+x^2(1$$
$$a^2-x^2$$
$$\overline{-2ax+x^2} \text{ remainder}$$

which divided by $-2x$ is $a-x)a^2-x^2(a+x$

$$a^2-ax$$
$$\overline{+ax-x^2}$$
$$+ax-x^2$$
$$\overline{\ast \quad \ast}$$

Hence it appears that $a-x$ is the greateſt common meaſure required.

Ex. 2. Required the greateſt common meaſure of $8a^2b^2-10ab^3+2b^4$, and $9a^4b-9a^3b^2+3a^2b^3-3ab^4$.

It is evident, from inſpection, that b is a ſimple diviſor of both quantities; it will therefore be a factor of the common meaſure required. Let the ſimple diviſors be now left out of each quantity, and they are reduced to $4a^2-5ab+b^2$ and $3a^3-3a^2b+ab^2-b^3$; but as the ſecond of theſe is to be divided by the firſt, it muſt be multiplied by 4 to make the diviſion ſucceed, and the operation will ſtand thus:

$$4a^2-5ab+b^2)12a^3-12a^2b+4ab^2-4b^3(3a$$
$$12a^3-15a^2b+3ab^2$$
$$\overline{+\ 3a^2b+ab^2-4b^3}$$

This remainder is to be divided by b, and the new dividend multiplied by 3, to make the diviſion again ſucceed, and the work will ſtand thus:

$$3a^2+ab-4b^2)12a^2-15ab+\ 3b^2(4$$
$$12a^2+\ 4ab-16b^2$$
$$\overline{-19ab+19b^2.}$$

This remainder is to be divided by $-19b$, which being done, and the laſt diviſor taken as a dividend as before, the reſt of the operation will be as follows:

$$a-b)3a^2+\ ab-4b^2(3a+4b$$
$$3a^2-3ab$$
$$\overline{+4ab-4b^2}$$
$$+4ab-4b^2$$
$$\overline{\ast \quad \ast}$$

from which it appears that the compound diviſor ſought is $a-b$, and remarking that the quantities propoſed have alſo a ſimple diviſor b, the greateſt common meaſure which is required will be $b(a-b)$.

50. The reaſon of the rule given in this problem may be deduced from the following conſiderations.

1. If two quantities have a compound diviſor common to both, and they be either multiplied or divided by any ſimple quantities, the reſults will each have the ſame compound diviſor. Thus the quantities $p(a-x)$ and $q(a-x)$ have the common diviſor $a-x$, and the quantities $np\,(a-x)$, $rq\,(a-x)$ have each the very ſame diviſor.

2. In the operation of diviſion, whatever quantity meaſures both the diviſor and dividend, the ſame will alſo meaſure the remainder. For let x be ſuch a quantity, then the diviſor and dividend may be repreſented by ax and bx; let q be the quotient, and the remainder will evidently be $bx-qax$, which is evidently diviſible by x.

3. Whatever quantity meaſures both the diviſor and remainder, the ſame will alſo meaſure the dividend.

For let the diviſor be ax, and the remainder rx, then, q denoting the quotient, the dividend will be $aqx+rx$, which, as well as the diviſor and dividend, is diviſible by x.

51. Let us apply theſe obſervations to the laſt example. From the firſt obſervation, the reaſon for leaving out the ſimple quantities in the courſe of the operation, as well as for multiplying by certain other quantities, to make the diviſions ſucceed, is obvious; and from the ſecond obſervation it appears, that whatever quantity meaſures $4a^2-5ab+b^2$, and $12a^3-12a^2b+4ab^2-4b^3$, the ſame muſt meaſure $3a^2b+ab^2-4b^3$, the firſt remainder, as alſo $-19ab+19ab^2$ the ſecond remainder; but the only compound diviſor which this laſt quantity can have is $a-b$, which is alſo found to be a diviſor of $3a^2+ab-4b^2$, or of $3a^2b+ab^2-4b^3$ the firſt remainder, therefore, by the third obſervation, $a-b$ muſt alſo be a diviſor of $12a^2-15ab+3b^2$, or of $4a^2-5ab+b^2$, the firſt diviſor, and therefore alſo it muſt be a diviſor of $12a^3-12a^2b+4ab^2-4b^3$ the firſt dividend, ſo that $a-b$ is the greateſt common meaſure as was required.

52. Prob. II. *To Reduce a Fraction to its loweſt Terms.*

Rule. Divide both numerator and denominator by their greateſt common meaſure, which may be found by prob. 1.

Ex. 1. Reduce $\frac{56a^2bc}{24adc^2}$ to its loweſt terms.

It appears from inſpection, that the greateſt common meaſure is $8ac$, and dividing both numerator and denominator by this quantity, we have $\frac{56a^2bc}{24adc^2}=\frac{7ab}{3dc}$.

Ex. 2. Reduce $\frac{a^2x-x^3}{a^3-2a^2x+ax^2}$ to its loweſt terms.

We have already found in the firſt example of prob. 1. that the greateſt common meaſure of the numerator and denominator is $a-x$; and dividing both by this quantity we have

$$\frac{a^2x-x^3}{a^3-2a^2x+ax^2}=\frac{ax+x^2}{a^2-ax}.$$

In like manner we find $\frac{9a^4b-9a^3b^2+3a^2b^3-3ab^4}{8a^2b^2-10ab^3+2b^4}=\frac{9a^3+3ab^2}{8ab-2b^2}$; the common meaſure being $b\,(a-b)$ as was ſhown in example 2. problem 1.

53. Prob. III. *To Reduce a mixed Quantity to an improper Fraction.*

Rule. Multiply the integer by the denominator of the fraction, and to the product add the numerator, and the denominator being placed under this ſum will give the improper fraction required.

Ex.

Ex. 1. Let $x+\frac{x^2}{a}$, and $x-\frac{a^2-x^2}{x}$ be reduced to improper fractions.

First $x+\frac{x^2}{a}=\frac{ax+x^2}{a}$, the answer.

And $x-\frac{a^2-x^2}{x}=\frac{x^2-a^2+x^2}{x}=\frac{2x^2-a^2}{x}$, Ans.

Ex. 2. Reduce $a-x+\frac{x^2}{a+x}$ to an improper fraction.

$$a-x+\frac{x^2}{a+x}=\frac{(a+x)(a-x)+x^2}{a+x}=\frac{a^2}{a+x}, \text{ Ans.}$$

54. Prob. IV. *To Reduce an improper Fraction to a whole or mixed Number.*

Rule. Divide the numerator by the denominator for the integral part, and place the remainder, if any, over the denominator, and it will be the mixed quantity required.

Ex. 1. Reduce $\frac{ax+a^2}{x}$ to a whole or mixed quantity.

$\frac{ax+a^2}{x}=a+\frac{a^2}{x}$ the answer required.

Ex. 2. Reduce $\frac{ax+2x^2}{a+x}$ also $\frac{x^2-y^2}{x-y}$ to whole or mixed quantities.

First $\frac{ax+2x^2}{a+x}=x+\frac{x^2}{a+x}$ the answer.

And $\frac{x^2-y^2}{x-y}=x+y$ a whole quantity which is the answer.

55. Prob. V. *To Reduce Fractions of different Denominators to others of the same value which shall have a common Denominator.*

Rule. Multiply each numerator separately into all the denominators except its own for the new numerators, and all the denominators together for the common denominator.

Ex. 1. Reduce $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$ to fractions of equal value which have a common denominator.

$$\left.\begin{array}{l} a\times d\times f=adf \\ c\times b\times f=cbf \\ e\times b\times d=ebd \end{array}\right\} \text{New numerators.}$$

$b\times d\times f=bdf$ Common denominator.

Hence we find $\frac{a}{b}=\frac{adf}{bdf}$, $\frac{c}{d}=\frac{cbf}{bdf}$ and $\frac{e}{f}=\frac{ebd}{bdf}$, where the new fractions have a common denominator, as was required.

Ex. 2. Reduce $\frac{ax}{a-x}$ and $\frac{a^2-x^2}{a+x}$ to fractions of equal value and having a common denominator.

$$\left.\begin{array}{l} ax(a+x)=a^2x+ax^2 \\ (a^2-x^2)(a-x)=a^3-a^2x-ax^2+x^3 \end{array}\right\} \text{new numerators.}$$

$a-x)(a+x)=a^2-x^2$ the common denominator.

Hence $\frac{ax}{a-x}=\frac{a^2x+ax^2}{a^2-x^2}$ and $\frac{a^2-x^2}{a+x}=\frac{a^3-a^2x-ax^2+x^3}{a^2-x^2}$.

56. Prob. VI. *To Add or Subtract Fractions.*

Rule. Reduce the fractions to a common denominator, and add or subtract their numerators, and the sum or difference placed over the common denominator, is the sum or remainder required.

Ex. 1. Add together $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$.

$$\frac{a}{b}=\frac{adf}{bdf}$$
$$\frac{c}{d}=\frac{bcf}{bdf}$$
$$\frac{e}{f}=\frac{bde}{bdf}$$

Hence $\frac{a}{b}+\frac{c}{d}+\frac{e}{f}=\frac{adf+bcf+bde}{bdf}$ the sum required.

Ex. 2. From $\frac{a+x}{a}$ subtract $\frac{a}{a+x}$.

$$\frac{a+x}{a}=\frac{a^2+2ax+x^2}{a^2+ax}$$
$$\frac{a}{a+x}=\frac{a^2}{a^2+ax}$$

Hence $\frac{a+x}{a}-\frac{a}{a+x}=\frac{2ax+x^2}{a^2+ax}$.

Ex. 3. Add together $\frac{x+2}{3}$, $\frac{x}{4}$ and $\frac{x-5}{2}$.

$$\frac{x+2}{3}+\frac{x}{4}+\frac{x-5}{2}=\frac{8x+16+6x+12x-60}{24}=\frac{13x-22}{12}.$$

If it be required to add or subtract mixed quantities, they may either be reduced to the form of fractions by prob. 3. and then added, or subtracted, or else these operations may be performed first on the integer quantities, and afterwards on the fractions.

57. Prob. VII. *To Multiply Fractions.*

Rule. Multiply the numerators of the fractions for the numerator of the product, and the denominators for the denominator of the product.

Ex. 1. Multiply $\frac{b}{a}$ by $\frac{d}{c}$

$\frac{b}{a}\times\frac{d}{c}=\frac{bd}{ac}$ the product required.

Ex. 2. Multiply $\frac{a+b}{c}$ by $\frac{a-b}{d}$.

$\frac{a+b}{c}\times\frac{a-b}{d}=\frac{a^2-b^2}{cd}$, the product.

If it be required to multiply an integer by a fraction, the integer may be considered as having unity for a denominator. Thus $(a+x)\times\frac{3d}{c}=\frac{a+x}{1}\times\frac{3d}{c}=\frac{3ad+3dx}{c}$.

Mixed quantities may be multiplied after being reduced to the form of fractions by prob. 3. Thus $\left(b+\frac{bx}{a}\right)\times\frac{a}{x}=\frac{ab+bx}{a}\times\frac{a}{x}=\frac{a^2b+abx}{ax}=\frac{ab+bx}{x}$.

58. The reason of the rule for multiplication may be explained thus. If $\frac{a}{b}$ is to be multiplied by c, the product will evidently be $\frac{ac}{b}$; but if it is only to be multiplied by $\frac{c}{d}$, the former product must be divided by d, and it becomes $\frac{ac}{bd}$ which is the product required. Or let $\frac{a}{b}=m$, and $\frac{c}{d}=n$, then $a=bm$ and $c=dn$ and $ac=bdmn$; hence mn, or $\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd}$.

59. Prob. VIII. *To Divide Fractions.*

Rule. Multiply the denominator of the divisor by the numerator of the dividend for the numerator of the quotient. Then multiply the numerator of the divisor by the denominator of the dividend for the denominator of the quotient.

Or, multiply the dividend by the reciprocal of the divisor, the product will be the quotient required.

Ex. 1. Divide $\frac{a}{b}$ by $\frac{c}{d}$.

$\frac{c}{d}\Big)\frac{a}{b}\Big(\frac{ad}{bc}$ the quotient required, or $\frac{a}{b}\times\frac{d}{c}=\frac{ad}{bc}$ as before.

Ex. 2. Divide $\frac{a^2+ab}{2x}$ by $\frac{3a^2}{a-b}$.

$\frac{3a^2}{a-b}\Big)\frac{a^2+ab}{2x}\Big(\frac{a^3-ab^2}{6a^2x}=\frac{a^2-b^2}{6ax}$ the quotient.

If either the divisor or dividend be an integer quantity, it may be represented as a fraction, by placing unity for a denominator; or if it be a mixed quantity, it may be reduced to a fraction by prob. 3. and the operation of division performed agreeably to the rule.

60. The reason of the rule for division may be explained thus, let it be required to divide $\frac{c}{d}$ by $\frac{a}{b}$. If $\frac{c}{d}$ is to be divided by a, the quotient is $\frac{c}{ad}$, but if it is to be divided by $\frac{a}{b}$, then the last quotient must be multiplied by b; thus we have $\frac{cb}{ad}$ for the quotient required. Or let $\frac{a}{b}=m$, and $\frac{c}{d}=n$, then $a=bm$ and $c=dn$; also $ad=bdm$ and $bc=bdn$; therefore $\frac{bdn}{bdm}=\frac{n}{m}=\frac{bc}{ad}$.

Sect. III. *Of Involution and Evolution.*

61. In treating of multiplication, we have observed, that when a quantity is multiplied by itself any number of times, the product is called a *power* of that quantity, while the quantity itself, from which the powers are formed, is called the *root* (§ 36.) Thus a, a^2, and a^3 are the first, second, and third powers of the root a; and in like manner $\frac{1}{a}$, $\frac{1}{a^2}$, and $\frac{1}{a^3}$, denote the same powers of the root $\frac{1}{a}$.

62. But before considering more particularly what relates to powers and roots, it will be proper to observe, that the quantities $\frac{1}{a}$, $\frac{1}{a^2}$, $\frac{1}{a^3}$, &c. admit of being expressed under a different form; for, like as the quantities a, a^2, a^3, &c. are expressed as *positive* powers of the root a, so the quantities $\frac{1}{a}$, $\frac{1}{a^2}$, $\frac{1}{a^3}$, &c. may be respectively expressed thus, a^{-1}, a^{-2}, a^{-3}, &c. and considered as *negative* powers of the root a.

63. This method of expressing the fractions $\frac{1}{a}$, $\frac{1}{a^2}$, $\frac{1}{a^3}$, as powers of the root a, but with negative indices, is a consequence of the rule which has been given for the division of powers; for we may consider $\frac{1}{a}$ as the quotient arising from the division of any power of a by the next higher power, for example from the division of the 2d by the 3d, and so we have $\frac{1}{a}=\frac{a^2}{a^3}$; but since powers of the same quantity are divided by subtracting the exponent of the divisor from that of the dividend (§ 40), it follows, that $\frac{a^2}{a^3}=a^{2-3}=a^{-1}$; therefore the fraction $\frac{1}{a}$ may also be expressed thus, a^{-1}. By considering $\frac{1}{a^2}$ as equal to $\frac{a^2}{a^4}$, it will appear in the same manner that $\frac{1}{a^4}=\frac{a^2}{a^2}=a^{-2}$; and, proceeding in this way, we get $\frac{1}{a^3}=\frac{a^2}{a^5}=a^{-3}$, $\frac{1}{a^4}=\frac{a^2}{a^6}=a^{-4}$, &c. and so on, as far as we please. It also appears, that unity or 1 may be represented by a^0, where the exponent is a cypher, for $1=\frac{a^2}{a^2}=a^{2-2}=a^0$.

64. The rules which have been given for the multiplication and division of powers with positive exponents will apply in every case, whether the exponents be positive or negative, and this must evidently take place, for the mode of notation, by which we represent fractional quantities as the powers of integers, but with negative exponents has been derived from those rules. Thus $\frac{1}{a^2}\times a^3$ or $a^{-2}\times a^3=a^{-2+3}=a^{-1}=\frac{1}{a}$, also $\frac{1}{x^2}\times$

$\frac{1}{x^3}$

$\frac{1}{x^3}$ or $x^{-2}\times x^{-3}=x^{-2-3}=x^{-5}=\frac{1}{x^5}$ and $\frac{1}{x^3}\times x^3$ or $x^{-3}\times x^{+3}=x^{-3+3}=x^0=1$.

65. From this method of notation it appears, that any quantity may be taken from the denominator of a fraction, and placed in the numerator, by changing the sign of its exponent; and hence it follows, that every fraction may also be represented as an integer quantity. Thus $\frac{a^2}{bc^3}$ denotes the same thing as $\frac{a^2b^{-1}}{c^3}$ or as $a^2b^{-1}c^{-3}$, also $\frac{a^2}{(x-1)^3}$ may be otherwise expressed thus, $a^2(x-1)^{-3}$.

Of Involution.

66. Involution is the method of finding any power of any assigned quantity, whether it be simple or compound; hence its rules are easily derived from the operation of multiplication.

Case 1. When the quantity is simple.

Rule. Multiply the exponents of the letters by the index of the power required, and raise the coefficient to the same power.

Note. If the sign of the quantity be + all its powers will be positive; but if it be —, then all its powers whose exponents are even numbers are positive, and all its powers whose exponents are odd numbers are negative.

Ex. 1. Required the cube, or third power of $2a^2x$. $(2a^2x)^3=2\times2\times2a^{2\times3}x^{1\times3}=8a^6x^3$, the answer.

Ex. 2. Required the fifth power of $-3a^2x^3$ $(-3a^2x^3)^5=-243a^{10}x^{15}$, the answer.

Ex. 3. Required the fourth power of $-\frac{2ax^2}{3b^2y}$.

$$\left(\frac{-2ax^2}{3b^2y}\right)^4=\frac{16a^4x^8}{81b^8y^4} \text{ the answer.}$$

Case 2. When the quantity is compound.

Rule. The powers must be found by a continual multiplication of the quantity by itself.

Ex. Required the first four powers of the binomial quantity $a+x$.

$a+x$ the root, or first power
$a+x$

---

a^2+ax
$\quad +ax+x^2$

$a^2+2ax+x^2$ the square, or second power
$a+x$

$a^3+2a^2x+ax^2$
$\quad +a^2x+2ax^2+x^3$

$a^3+3a^2x+3ax^2+x^3$ the cube, or third power
$a+x$

$a^4+3a^3x+3a^2x^2+ax^3$
$\quad +a^3x+3a^2x^2+3ax^3+x^4$

$a^4+4a^3x+6a^2x^2+4ax^3+x^4$ the fourth power.

If it be required to find the same powers of $a-x$, it will be found, that

$a-x$ is the root, or first power;
$a^2-2ax+x^2$ the square, or 2d power;
$a^3-3a^2x+3ax^2-x^3$ the cube, or 3d power;
$a^4-4a^3x+6a^2x^2-4ax^3+x^4$ the 4th power.

Hence it appears, that the powers of $a+x$ differ from the powers of $a-x$, only in this respect, that in the former the signs of the terms are all positive, but in the latter, they are positive and negative alternately.

67. Besides the method of finding the powers of a compound quantity by multiplication, which we have just now explained, there is another, more general, as well as more expeditious, by which a quantity may be raised to any power whatever without the trouble of finding any of the inferior powers, namely, by means of what is commonly called the *binomial theorem*. This theorem may be expressed as follows. Let $a+x$ be a binomial quantity, which is to be raised to any power denoted by the number n, then $(a+x)^n=a^n+\frac{n}{1}a^{n-1}x+\frac{n(n-1)}{1\cdot2}a^{n-2}x^2+\frac{n(n-1)(n-2)}{1\cdot2\cdot3}a^{n-3}x^3+\frac{n(n-1)(n-2)(n-3)}{1\cdot2\cdot3\cdot4}a^{n-4}x^4+\frac{n(n-1)(n-2)(n-3)(n-4)}{1\cdot2\cdot3\cdot4\cdot5}a^{n-5}x^5+$, &c. This series will always terminate when n is any whole positive number, by reason of some one of the factors $n-1$, $n-2$, &c. becoming $=0$; but if n be either a negative, or fractional number, the series will consist of an infinite number of terms; as, however, we mean to treat in this section only of the powers of quantities when their exponents are whole positive numbers we shall make no farther remarks upon any other; we shall afterwards give a demonstration of the theorem, and shew its application to fractional and negative powers in treating of infinite series. The nth power of $a-x$ will not differ from the same power of $a+x$ but in the signs of the terms which compose it, for it will stand thus: $(a-x)^n=a^n+\frac{n}{1}a^{n-1}x+\frac{n(n-1)}{1\cdot2}a^{n-2}x^2-\frac{n(n-1)(n-2)}{1\cdot2\cdot3}a^{n-3}x^3+\frac{n(n-1)(n-2)(n-3)}{1\cdot2\cdot3\cdot4}a^{n-4}x^4-$, &c. where the signs are + and — alternately.

Ex. 1. Let it be required to raise $a-x$ to the fifth power.

Here n the exponent of the power being 5, the first term a^n of the general theorem will be equal to a^5, the second $na^{n-1}x=5a^4x$, the third $\frac{n(n-1)}{1\cdot2}a^{n-2}x^2=\frac{5\times4}{1\times2}a^3x^2=10a^3x^2$, the fourth $\frac{n(n-1)(n-2)}{1\cdot2\cdot3}a^{n-3}x^3=\frac{5\times4\times3}{1\times2\times3}a^2x^3$, $=10a^2x^3$, the fifth $\frac{n(n-1)(n-2)(n-3)}{1\cdot2\cdot3\cdot4}a^{n-4}x^4=\frac{5\times4\times3\times2}{1\times2\times3\times4}ax^4=5ax^4$ and the sixth and last $\frac{n(n-1)(n-2)(n-3)(n-4)}{1\cdot2\cdot3\cdot4\cdot5}a^{n-5}x^5=\frac{5\times4\times3\times2\times1}{1\times2\times3\times4\times5}a^0x^5=x^5$; the remaining terms of of the general theorem all vaniſh, by reaſon of the factor $n-5=0$ by which each of them is multiplied, ſo that we get $(a+x)^5=a^5+5a^4x+10a^3x^2+10a^2x^3+5ax^4+x^5$.

Ex. 2. It is required to raiſe $2d-\frac{z}{3}$ to the third power.

In this caſe $n=3$, ſo that if we put $a=2d$ and $x=\frac{z}{3}$ we have the firſt term of the general theorem, or $a^n=8d^3$, the ſecond $\frac{n}{1}a^{n-1}x=3\times4d^2\times\frac{z}{2}=6d^2z$, the third $\frac{n(n-1)}{1\cdot2}a^{n-2}x^2=3\times2d\times\frac{z^2}{9}=\frac{2dz^2}{3}$, and the fourth and laſt term $\frac{n(n-1)(n-2)}{1\cdot2\cdot3}a^{n-3}x^3=\frac{z^3}{27}$, and ſince the ſigns of the terms of any power of $a-x$ are $+$ and $-$ alternately we have $\left(2d-\frac{z}{3}\right)^3=8d^3-6d^2z+\frac{2dz^2}{3}-\frac{z^3}{27}$.

68. If the quantity to be involved conſiſts of more than two terms, as if $p+q-r$ were to be raiſed to the 2d power, put $p=a$ and $q-r=b$ then $(p+q-r)^2=(a+b)^2=a^2+2ab+b^2=p^2+2p(q-r)+(q-r)^2$ but $2p(q-r)=2pq-2pr$, and by the general theorem $(q-r)^2=q^2-2qr+r^2$, therefore, we get $(p+q-r)^2=p^2+2pq-2pr+q^2-2qr+r^2$; and by a ſimilar method of procedure a quantity conſiſting of four or more terms may be raiſed to any power.

Of Evolution.

69. Evolution is the reverſe of involution, or it is the method of finding the root of any quantity, whether ſimple or compound, which is conſidered as a power of that root; hence it follows that its operations, generally ſpeaking, muſt be the reverſe of thoſe of involution.

70. To denote that the root of any quantity is to be taken the ſign $\surd$ (called the *radical ſign*) is placed before it, and a ſmall number placed over the ſign to expreſs the denomination of the root. Thus $\sqrt[2]{a}$ denotes the ſquare root of a, $\sqrt[3]{a}$ its cube root, $\sqrt[4]{a}$ its fourth root, and in general, $\sqrt[n]{a}$ its nth root. The number placed over the radical ſign is called the *index* or *exponent* of the root, and is uſually omitted in expreſſing the ſquare root, thus either $\sqrt[2]{a}$ or $\sqrt{a}$ denotes the ſquare root of a.

71. *Caſe* 1. When roots of ſimple quantities are to be found.

Rule. Divide the exponents of the letters by the index of the root required, and prefix the root of the numeral coefficient, the reſult will be the root required.

Note 1. The root of any poſitive quantity may be either poſitive or negative, if the index of the root be an even number; but if it be an odd number, the root can be poſitive only.

2. The root of a negative quantity is alſo negative when the index of root is an odd number.

3. But if the quantity be negative, and the index of the root even, then no root can be aſſigned.

Ex. 1. Required the ſquare root of $36a^2x^4$.

Here the index of the root is 2, and the root of the coefficient 6, therefore $\sqrt{36a^2x^4}=+6ax^2$ or $\sqrt{36a^2x^4}=-6ax^2$, for either of theſe quantities, when multiplied by itſelf, produces $36a^2x^4$; ſo that the root required is $\pm6ax^2$, where the ſign $\pm$ denotes that the quantity to which it is prefixed may be conſidered either as poſitive or negative.

Ex. 2. Required the cube root of $125a^6x^9$.

Here the index of the root is 3, and the root of the coefficient 5, therefore $\sqrt[3]{125a^6x^9}=5a^2x^3$ the root required; and in like manner the cube root of $-125a^6x^9$ is found to be $-5a^2x^3$.

72. If it be required to extract the ſquare of $-a^2$, it will immediately appear that no root can be aſſigned; for it can neither be $+a$, nor $-a$, ſeeing that each of theſe quantities when ſquared produces $+a^2$, the root required is therefore ſaid to be *impoſſible*, and may be expreſſed thus: $\sqrt{-a^2}$.

The root of a fraction is found by extracting that root out of both numerator and denominator. Thus the ſquare root of $\frac{4a^2x^4}{9b^2y^6}$ is $\frac{2xa^2}{3by^3}$.

Caſe 2. When the quantity of which the root is to be extracted is compound.

73. I. To extract the ſquare root.

Range the terms of the quantity according the powers of the letters, as in diviſion.

Find the ſquare root of the firſt term for the firſt part of the root ſought, ſubtract its ſquare from the given quantity, and divide the remainder by double the part already found, and the quotient is the ſecond term of the root.

Add the ſecond part to double the firſt, and multiply their ſum by the ſecond part, ſubtract the product from the remainder, and if nothing remain, the ſquare root is obtained. But if there is a remainder, it muſt be divided by the double of the parts already found, and the quotient will give the third term of the root, and ſo on.

Ex. 1. Required the ſquare root of $a^2+2ax+x^2$.

$$\begin{array}{r|l}
 & a^2+2ax+x^2\,(a+x \text{ the root required.} \\
 & a^2 \\
\hline
2a+x & +2ax+x^2 \\
\times x & +2ax+x^2 \\
\hline
 & \quad * \quad\quad * \\
\end{array}$$

Ex. 2. Required the ſquare root of $x^4-2x^3+\frac{3}{2}x^2-\frac{x}{2}+\frac{1}{16}$.

$$\begin{array}{rl}
 & x^4-2x^3+\frac{3}{2}x^2-\frac{x}{2}+\frac{1}{16}\left(x^2-x+\frac{1}{4}\right. \\
 & x^4 \\
\hline
2x^2-x\;) & -2x^3+\frac{3}{2}x^2 \\
\times -x & -2x^3+\;x^2 \\
\hline
2x^2-2x+\frac{1}{4}\;) & \frac{x^2}{2}-\frac{x}{2}+\frac{1}{16} \\
\times\frac{1}{4} & \frac{x^2}{2}-\frac{x}{2}+\frac{1}{16} \\
\hline
 & * \quad * \quad *
\end{array}$$

74. To underſtand the reaſon of the rule for finding the ſquare root of a compound quantity, it is only neceſſary to involve any quantity, as $a+b+c$ to the ſecond power, and obſerve the compoſition of its ſquare; for we have $(a+b+c)^2=a^2+2ab+b^2+2ac+2bc+c^2$ but $2ab+b^2=(2a+b)b$ and $2ac+2bc+c^2=(2a+2b+c)c$ therefore,

$$(a+b+c)^2=a^2+(2a+b)b+(2a+2b+c)c$$

and from this expreſſion the manner of deriving the rule is obvious.

As an illuſtration of the common rule for extracting the ſquare root of any propoſed number, we ſhall ſuppoſe that the root of 59049 is required.

Accordingly we have $(a+b+c)^2=59049$, and from hence we are to find the values of a, b and c.

$$\begin{array}{r|l}
 & 59049(200=a \\
a^2=200\times200= & 40000 \quad 40=b \\
 & \qquad\quad\; 3=c \\
\hline
2a=400 & 19049 \\
b=\;\;40 & \\
\hline
2a+b=440 & 17600=(2a+b)b \\
\hline
2a+2b=480 & 1449 \\
c=\;\;\;3 & \\
\hline
2a+2b+c=483 & 1449=(2a+2b+c)c \\
\hline
\end{array}$$

Hence 243 is the root required

The ſame example when wrought by the common rule (ſee ARITHMETIC) will ſtand thus:

$$\begin{array}{rl}
 & 59049(243 \text{ the root required.} \\
 & 4 \\
\hline
44) & 190 \\
 & 176 \\
\hline
483) & 1449 \\
 & 1449 \\
\hline
\end{array}$$

and by a compariſon of the two operations, the reaſon of the common rule is obvious.

75. II. To extract the cube root.

Range the terms of the quantity according to the powers of ſome one of the letters.

Find the root of the firſt term, for the firſt part of the root ſought; ſubtract its cube from the whole quantity, and divide the remainder by 3 times the ſquare of the part already found, and the quotient is the ſecond part of the root.

Add together, 3 times the ſquare of the part of the root already found, 3 times the product of that part and the ſecond part of the root, and the ſquare of the ſecond part; multiply the ſum by the ſecond part, and ſubtract the product from the firſt remainder, and if nothing remain, the root is obtained; but if there is a remainder, it muſt be divided by 3 times the ſquare of the ſum of the parts already found, and the quotient is a third term of the root, and ſo on, till the whole root is obtained.

Ex. Required the cube root of $a^3+3a^2x+3ax^2+x^3$.

$$\begin{array}{rl}
 & a^3+3a^2x+3ax^2+x^3(a+x \text{ the root required.} \\
 & a^3 \\
\hline
3a^2+3ax+x^2) & 3a^2x+3ax^2+x^3 \\
 & 3a^2x+3ax^2+x^3 \\
\hline
 & \;\;*\qquad *\qquad *
\end{array}$$

76. The reaſon of the preceding rule is evident from the compoſition of a cube, for if any quantity as $a+b+c$ be raiſed to the third power we have $(a+b+c)^3=a^3+(3a^2+3ab+b^2)b+(3(a+b)^2+3(a+b)c+c^2)c$, and by conſidering in what manner the terms a, b and c are developed from this expreſſion for the cube of their ſum, we alſo ſee the reaſon for the common rule for extracting the cube root in numbers. Let it be required to find the cube root of 13312053, where the root will evidently conſiſt of three figures; let us ſuppoſe it to be repreſented by $a+b+c$ and the operation for finding the numerical values of theſe quantities may ſtand as follows.

$$\begin{array}{r|l}
 & 13312053(200=a \\
=a^3= & 8000000 \quad 30=b \\
 & \qquad\qquad\;\, 7=c \\
\hline
3a^2=120000 & 5312053 \quad \text{———} \\
3ab=\;\;18000 & \qquad\quad 237 \text{ the root required.} \\
b^2=\;\;\;\;\;900 & \\
\hline
3a^2+3ab+b^2=138900 & 4167000=(3a^2+3ab+b^2)b \\
\hline
3(a+b)^2=158700 & 1145053 \\
3(a+b)c=\;\;\;4830 & \\
c^2=\;\;\;\;\;\;49 & \\
\hline
3(a+b)^2+3(a+b)c+c^2=163579 & 1145053=[3(a+b)^2+3(a+b)c+c^2]c \\
\hline
\end{array}$$

The

The operation as performed by the common rule (see ARITHMETIC) will stand thus:

13312053(237 the root required.
8

12..	5312
18.	
9	
1389	4167
1587..	1145053
383.	
49	
163579	1145053

77. III. To extract any other root.

Rule. Range the quantity, of which the root is to be found, according to the powers of its letters, and extract the root of the first term, and that shall be the first member of the root required.

Involve the first member of the root to a power less by unity than the number that denominates the root required, and multiply the power that arises by the number itself; divide the second term of the given quantity by the product, and the quotient shall give the second member of the root required.

Find the remaining members of the root in the same manner by considering those already found as making one term.

Ex. Required the cube root of $x^6+6x^5-40x^3+96x-64$

$$x^6+6x^5-40x^3+96x-64(x^2+2x-4$$
$$(x^2)^3=x^6$$
$$3x^4)6x^5$$
$$(x^2+2x)^3=x^6+6x^5+12x^4+8x^3$$
$$3x^4+,\ \&c.)-12x^4$$
$$(x^2+2x-4)^3=x^6+6x^5-40x^3+96x-64$$

*

In this example, the cube root of x^6, or x^2, is the first member of the root, and to find a second member the first is raised to the power next lower, or to the second power, and also multiplied by 3, the index of the root required; thus we get $3x^4$ for a divisor, by which the second term $6x^5$ being divided, we find $2x$ for the second member of the root. We must now consider x^2+2x as forming one term; accordingly having subtracted its cube from the quantity, of which the root is sought, we have $-12x^4-$, &c: for a new dividend; and having also raised x^2+2x to the second power, and multiplied the result by 3, we find $3x^4+$, &c. for a divisor. As it is only the terms which contain the highest powers of the dividend and divisor that we have occasion for, the remaining terms are expressed by &c. Having divided $-12x^4$ by $3x^4$, we find -4 for the third term of the root; and because it appears that x^2+2x-4, when raised to the third power, gives a result the very same with the proposed power, we conclude x^2+2x-4 to be the root sought.

78. In the preceding examples, the quantities whose roots were to be found have been all such as could have their roots expressed by a finite number of terms; but it will frequently happen, that the root cannot be otherwise assigned than by a series consisting of an infinite number of terms: the preceding rules, however, will serve to determine any number of terms of the series. Thus the square root of a^2+x^2 will be found to be $a+\frac{x^2}{2a}-\frac{x^4}{8a^3}+\frac{x^6}{16a^5}-\frac{5x^8}{128a^7}+$ &c. and the cube root of a^3+x^3 will stand thus $a+\frac{x^3}{3a^2}-\frac{x^6}{9a^5}+\frac{5x^9}{81a^8}-\frac{10x^{12}}{243a^{11}}+$, &c. but as the extraction of roots in the form of series can be more easily performed by other methods, we shall refer the reader to section 17. which treats of series, where this subject is again resumed.

SECT. IV. *Of Surds.*

79. It has been already observed (71), that the root of any proposed quantity is found by dividing the exponent of the quantity by the index of the root; and the rule has been illustrated by suitable examples, in all which, however, the quotient expressing the exponent of the result is a whole number; but there may be cases in which the quotient is a fraction. Thus if the cube root of a^2 were required, it might be expressed, agreeably to the method of notation already explained, either thus $\sqrt[3]{a^2}$, or thus $a^{\frac{2}{3}}$.

80. Quantities which have fractional exponents are called *surds*, or imperfect powers, and are said to be *irrational*, in opposition to others with integral exponents which are called *rational*.

81. Surds may be denoted by means of the radical sign, but it will often be more convenient to use the notation of fractional exponents; the following examples will shew how they may be expressed either way.

$$\sqrt[3]{a}=a^{\frac{1}{3}},\ \sqrt{4ab^2}=2ba^{\frac{1}{2}},\ \sqrt[4]{a^3b^2}=a^{\frac{3}{4}}b^{\frac{2}{4}},\ \sqrt{a^2+b^2}=(a^2+b^2)^{\frac{1}{2}},\ \sqrt[5]{(a-b)^2}=(a-b)^{\frac{2}{5}},\ \frac{\sqrt{a+b}}{\sqrt{ab}}=(a+b^{\frac{1}{2}}a^{-\frac{1}{2}}b^{-\frac{1}{2}}.$$

82. The operations concerning surds depend on the following principle. If the numerator and denominator of a fractional exponent be either both multiplied, or both divided by the same quantity, the value of the power is the same. Thus $a^{\frac{m}{n}}=a^{\frac{cm}{cn}}$. For let $a^{\frac{m}{n}}=b$, then, raising both to the power n, $a^m=b^n$, and farther raising both to the power c we get $a^{cm}=b^{cn}$; let the root cn be now taken and we find $a^{\frac{cm}{cn}}=b=a^{\frac{m}{n}}$.

83. PROB. I. *To Reduce a rational Quantity to the form of a Surd of any given denomination.*

Rule. Reduce the exponent of the quantity to the form of a fraction of the same denomination as the given surd.

Ex. 1.

Ex. 1. Reduce a^2 to the form of the cube root.

Here the exponent 2 muſt be reduced to the form of a fraction having 3 for a denominator, which will be the fraction $\frac{6}{3}$; therefore $a^2=a^{\frac{6}{3}}=\sqrt[6]{a^3}$.

Ex. 2. Reduce 5 to the form of the cube root, and $3ab^2$ to the form of the ſquare root.

Firſt $5=5^{\frac{3}{3}}=\sqrt[3]{5\times5\times5}=\sqrt[3]{125}$.

And $3ab^2=3^{\frac{2}{2}}a^{\frac{2}{2}}b^{\frac{4}{2}}=(3^2a^2b^4)^{\frac{1}{2}}=\sqrt{9a^2b^4}$

84. Prob. II. *To Reduce Surds of different denominations to others of the ſame value, and of the ſame denominations.*

Rule. Reduce the fractional exponents to others of the ſame value, and having the ſame common denominator.

Ex. 1. Reduce $\sqrt{a}$ and $\sqrt[3]{b^2}$, or $a^{\frac{1}{2}}$ and $b^{\frac{2}{3}}$ to other equivalent ſurds of the ſame denomination.

The exponents $\frac{1}{2}$, $\frac{2}{3}$, when reduced to a common denominator, are $\frac{3}{6}$ and $\frac{4}{6}$; therefore, the ſurds required are $a^{\frac{3}{6}}$ and $b^{\frac{4}{6}}$, or $\sqrt[6]{a^3}$ and $\sqrt[6]{b^4}$.

Ex. 2. Reduce $3^{\frac{1}{2}}$ and $2^{\frac{1}{3}}$ to ſurds of the ſame denomination.

The new exponents are $\frac{3}{6}$ and $\frac{2}{6}$, therefore we have $3^{\frac{1}{2}}=3^{\frac{3}{6}}=\sqrt[6]{3^3}=\sqrt[6]{27}$, and $2^{\frac{1}{3}}=2^{\frac{2}{6}}=\sqrt[6]{2^2}=\sqrt[6]{4}$.

And in the ſame way the ſurds $A^{\frac{1}{m}}$, $B^{\frac{1}{n}}$ are reduced to theſe two $\sqrt[mn]{A^n}$ and $\sqrt[mn]{B^m}$.

35. Prob. III. *To Reduce Surds to their moſt ſimple terms.*

Rule. Reſolve the ſurd into two factors, ſo that one of them may be a complete power, having its exponent diviſible by the index of the ſurd. Extract the root of that power, and place it before the remaining quantities, with the proper radical ſign between them.

Ex. 1. Reduce $\sqrt{48}$ to its moſt ſimple terms.

The number 48 may be reſolved into the two factors 16 and 3, of which the firſt is a complete ſquare; therefore $\sqrt{48}=(4^2\times3)^{\frac{1}{2}}=4\times3^{\frac{1}{2}}=4\sqrt{3}$.

Ex. 2. Reduce $\sqrt{98a^4x}$, and $\sqrt[3]{24a^3x+40a^3x^2}$, each to its moſt ſimple terms.

Firſt $\sqrt{98a^4x}=(7^2a^4\times2x)^{\frac{1}{2}}=7a^2\times(2x)^{\frac{1}{2}}=7a^2\sqrt{2x}$.

Alſo $\sqrt[3]{24a^3x+40a^3x^2}=(2^3a^3(3x+5x^2))^{\frac{1}{3}}=2a\sqrt[3]{3x+5x^2}$.

86. Prob. IV. *To Add and Subtract Surds.*

Rule. If the ſurds are of different denominations, reduce them to others of the ſame denomination, by prob. 2.; and then reduce them to their ſimpleſt terms by laſt problem. Then, if the ſurd part be the ſame in them all, annex it to the ſum, or difference of the rational parts, with the ſign of multiplication, and it will give the ſum, or difference required. But if the ſurd part be not the ſame in all the quantities, they can only be added, or ſubtracted by placing the ſigns + or — between them.

Ex. 1. Required the ſum of $\sqrt{27}$ and $\sqrt{48}$.

By prob. 3. we find $\sqrt{27}=3\sqrt{3}$ and $\sqrt{48}=4\sqrt{3}$, therefore $\sqrt{27}+\sqrt{48}=3\sqrt{3}+4\sqrt{3}=7\sqrt{3}$.

Ex. 2. Required the ſum of $3\sqrt[3]{\frac{1}{4}}$ and $5\sqrt[3]{\frac{1}{32}}$.

$3\sqrt[3]{\frac{1}{4}}=3\sqrt[3]{\frac{2}{8}}=\frac{3}{2}\sqrt[3]{2}$ and $5\sqrt[3]{\frac{1}{32}}=5\sqrt[3]{\frac{2}{64}}=\frac{5}{4}\sqrt[3]{2}$, therefore $3\sqrt[3]{\frac{1}{4}}+5\sqrt[3]{\frac{1}{8}}=\frac{3}{2}\sqrt[3]{2}+\frac{5}{4}\sqrt[3]{2}=\frac{11}{4}\sqrt[3]{2}$.

Ex. 3. Required the difference between $\sqrt{80a^4x}$ and $\sqrt{20a^2x^3}$.

$\sqrt{80a^4x}=(4^2a^4\times5x)^{\frac{1}{2}}=4a^2\sqrt{5x}$, and $\sqrt{20a^2x^3}=(2^2a^2x^2\times5x)^{\frac{1}{2}}=2ax\sqrt{5x}$; therefore $\sqrt{80a^4x}-\sqrt{20a^2x^3}=(4a^2-2ax)\sqrt{5x}$.

87. Prob. V. *To Multiply and Divide Surds.*

Rule. If they are ſurds of the ſame rational quantity, add and ſubtract their exponents.

But if they are ſurds of different rational quantities, let them be brought to others of the ſame denomination, by prob. 2. Then, by multipying or dividing theſe rational quantities, their product, or quotient may be ſet under the common radical ſign.

Note. If the ſurds have any rational coefficients, their product or quotient muſt be prefixed.

Ex. 1. Required the product of $\sqrt[3]{a^2}$ and $\sqrt[5]{a^3}$.

$\sqrt[3]{a^2}\times\sqrt[5]{a^3}=a^{\frac{2}{3}}\times a^{\frac{3}{5}}=a^{\frac{2}{3}+\frac{3}{5}}=a^{\frac{19}{15}}=\sqrt[15]{a^{19}}$, Anſ.

Ex. 2. Divide $\sqrt{a^2-b^2}$ by $\sqrt[3]{a+b}$.

Theſe ſurds when reduced to the ſame denomination are $(a^2-b^2)^{\frac{3}{6}}$ and $(a+b)^{\frac{2}{6}}$. Hence $\dfrac{\sqrt{a^2-b^2}}{\sqrt[3]{a+b}}=\left(\dfrac{(a^2-b^2)^3}{(a+b)^2}\right)^{\frac{1}{6}}=\left(\dfrac{(a+b)^3(a-b)^3}{(a+b)^2}\right)^{\frac{1}{6}}=\left((a+b)(a-b)^3\right)^{\frac{1}{6}}=\sqrt[6]{(a+b)(a-b)^3}$.

Ex. 3. Required the product of $5\sqrt{8}$ and $3\sqrt{5}$.

$5\sqrt{8}\times3\sqrt{5}=5\times3\times\sqrt{8}\times\sqrt{5}=15\times\sqrt{40}=15\times\sqrt{4\times10}=30\sqrt{10}$.

Ex. 4. Divide $8\sqrt[3]{56}$ by $4\sqrt[3]{2}$.

$$\frac{8\sqrt[3]{56}}{4\sqrt[3]{2}}=2\frac{\sqrt[3]{56}}{2}=2\sqrt[3]{28}.$$

Ex.

Proportion.

Ex. 5. Required the product of $x^{\frac{1}{m}}$ and $x^{\frac{1}{n}}$; alſo the quotient ariſing from the diviſion of $a^{\frac{1}{m}}$ by $b^{\frac{1}{n}}$.

First $x^{\frac{1}{m}} \times x^{\frac{1}{n}} = x^{\frac{1}{m}+\frac{1}{n}} = x^{\frac{m+n}{mn}} = \sqrt[mn]{x^{m+n}}$,

And $\dfrac{a^{\frac{1}{m}}}{b^{\frac{1}{n}}} = \left(\dfrac{a^n}{b^m}\right)^{\frac{1}{mn}} = \sqrt[mn]{\dfrac{a^n}{b^m}}$.

88. Prob. VI. *To Involve and Evolve Surds.*

Surds are involved or evolved in the ſame manner as any other quantities, namely, by multiplying or dividing their exponents by the index of the power, or root required. Thus the ſquare of $3\sqrt[3]{3}$ is $3 \times 3 \times (3)^{\frac{2}{3}} = 9 \cdot \sqrt[3]{9}$. The nth power of $x^{\frac{1}{m}}$ is $x^{\frac{m}{n}}$. The cube root of $\frac{1}{8}\sqrt{2}$ is $\frac{1}{2}(2)^{\frac{1}{6}} = \frac{\sqrt[6]{2}}{2}$ and the nth root of $x^{\frac{1}{m}}$ is $x^{\frac{1}{mn}}$.

89. If a compound quantity involve one or more ſurds, its powers may be found by multiplication. Thus the ſquare of $3+\sqrt{5}$ is found as follows:

$$\begin{array}{l} 3+\sqrt{5} \\ 3+\sqrt{5} \\ \hline 9+3\sqrt{5} \\ \quad +3\sqrt{5}+5 \\ \hline 9+6\sqrt{5}+5 = 14+6\sqrt{5} \end{array}$$

the ſquare required.

90. The ſquare root of a binomial, or reſidual ſurd $A+B$, or $A-B$ may be found thus. Take $\sqrt{A^2-B^2} = D$;

$$\text{then } \sqrt{A+B} = \sqrt{\frac{A+D}{2}} + \sqrt{\frac{A-D}{2}},$$

$$\text{and } \sqrt{A-B} = \sqrt{\frac{A+D}{2}} - \sqrt{\frac{A-D}{2}}.$$

Thus the ſquare root of $8+2\sqrt{7}$ is $1+\sqrt{7}$; and the ſquare root of $3-\sqrt{8}$ is $\sqrt{2}-1$. With reſpect to the extraction of the cube or any higher root no general rule can be given.

Sect. V. *Of Proportion.*

91. In comparing together any two quantities of the ſame kind in reſpect of magnitude, we may conſider how much the one is greater than the other, or elſe how many times the one contains either the whole, or ſome part of the other; or which is the ſame thing, we may conſider either what is the difference between the quantities, or what is the quotient ariſing from the diviſion of the one quantity by the other; the former of theſe is called their *arithmetical ratio*, and the latter their *geometrical ratio*. Theſe denominations, however, have been aſſumed arbitrarily, and have little or no connexion with the relations they are intended to expreſs.

I. *Of Arithmetical Proportion.*

92. When of four quantities the difference between the firſt and ſecond is equal to the difference between the third and fourth, the quantities are called *arithmetical proportionals*. Such, for example, are the numbers 2, 5, 9, 12; and, in general, the quantities a, $a+d$, b, $b+d$. If the two middle terms are equal, the quantities conſtitute what are called *three arithmetical proportionals*.

Arithmetical Proportion.

93. The moſt material property of four arithmetical proportionals is the following: If four quantities be arithmetically proportional, the ſum of the extreme terms is equal to the ſum of the means. Let the quantities be a, $a+d$, b, $b+d$, where d is the difference between the firſt and ſecond, and alſo between the third and fourth, the ſum of the extremes is $a+b+d$, and that of the means $a+d+b$; ſo that the truth of the proportion is evident. Hence it follows, that if any three quantities be arithmetically proportional, the ſum of the two extremes is double the mean.

94. If any three terms of four arithmetical proportionals be given, the fourth may be found from the preceding propoſition. Let a, b, c, be the firſt, ſecond, and fourth terms, and let x the third term be required; becauſe $a+c=b+x$; therefore $x=a+c-b$. In like manner any two of three arithmetical proportionals being ſuppoſed given, the remaining term may be readily found.

95. If a ſeries of quantities be ſuch, that the difference between any two adjacent terms is always the ſame, theſe terms form a *continued arithmetical proportion*. Thus the numbers 2, 4, 6, 8, 10, &c. form a ſeries in continued arithmetical proportion, and, in general, ſuch a ſeries may be repreſented thus:

$$a,\ a+d,\ a+2d,\ a+3d,\ a+4d,\ a+5d,\ a+6d,\ \&c.$$

where a denotes the firſt term, and d the common difference.

By a little attention to this ſeries, we readily diſcover that it has the following properties:

1. The laſt term of the ſeries is equal to the firſt term, together with the common difference taken as often as there are terms after the firſt. Thus, when the number of terms is 7, the laſt term is $a+6d$; and ſo on. Hence if z denote the laſt term, n the number of terms, and a and d expreſs the firſt term, and common difference, we have $z=a+(n-1)d$.

2. The ſum of the firſt and laſt term is equal to the ſum of any two terms at the ſame diſtance from them. Thus ſuppoſe the number of terms to be 7, then the laſt term is $a+6d$, and the ſum of the firſt and laſt, $2a+6d$; but the ſame is alſo the ſum of the ſecond and laſt but one, of the third and laſt but two, and ſo on till we come to the middle term, which, becauſe it is equally diſtant from the extremes, muſt be added to itſelf.

96. From this laſt mentioned property we derive a rule for finding the ſum of all the terms of the ſeries. For if the ſum of the firſt and laſt be taken, as alſo the ſum of the ſecond and laſt but one, of the third and laſt but two, and ſo on along the ſeries till we come to the ſum of the laſt and firſt terms, it is evident that we ſhall have as many ſums as there are terms, and each equal to the ſum of the firſt and laſt terms; but the aggregate of thoſe ſums is equal to all the terms of the ſeries taken twice, therefore the ſum of the firſt and laſt term, taken as often as there are terms, is equal to twice the ſum of all the terms, ſo that if s denote that ſum, we have $2s=n(a+z)$, and $s=\frac{n}{2}(a+z)$.

Hence

Hence the ſum of the odd numbers 1, 3, 5, 7, 9, &c. continued to n terms, is equal to the ſquare of the number of terms. For in this caſe $a=1$, $d=2$, $z=1+(n-1)d=2n-1$, therefore $s=\frac{n}{2}\times 2n=n^2$.

II. *Of Geometrical Proportion.*

97. When of four quantities, the quotient ariſing from the diviſion of the firſt by the ſecond is equal to that ariſing from the diviſion of the third by the fourth, theſe quantities are ſaid to be in *geometrical proportion*, or are called ſimply *proportionals*. Thus 12, 4, 15, 5, are four numbers in geometrical proportion; and in general, na, a, nb, b may expreſs any four proportionals, for $\frac{na}{a}=n$, and alſo $\frac{nb}{b}=n$.

98. To denote that any four quantities a, b, c, d, are proportional, it is common to place them thus, $a:b::c:d$, or thus $a:b=c:d$, which notation, when expreſſed in words, is read thus, a is to b as c to d, or the ratio of a to b is equal to the ratio of c to d.

The firſt and third terms of a proportion are called the *antecedents*, and the ſecond and fourth, the *conſequents*.

99. When the two middle terms of a proportion are the ſame, the remaining terms, and that quantity, conſtitute three geometrical proportionals; ſuch are 4, 6, 9, and in general na, a, $\frac{a}{n}$. In this caſe the middle quantity is called a mean proportional between the other two.

100. The principal properties of four proportionals are the following:

1. If four quantities be proportionals, the product of the extremes is equal to the product of the means. Let a, b, c, d, be four quantities, ſuch, that $a:b::c:d$; then from the nature of proportionals $\frac{a}{b}=\frac{c}{d}$; let theſe equal quotients be multiplied by bd, and we have $\frac{abd}{b}=\frac{cbd}{d}$, or $ad=bc$. Hence it follows that when three quantities are proportional, the product of the extremes is equal to the ſquare of the middle term. It alſo appears, that if any three of four proportionals be given, the remaining one may be found. Thus let a, b, c, the three firſt be given, and let it be required to find x the fourth term; becauſe $a:b::c:x$, $ax=bc$, and dividing by a, $x=\frac{bc}{a}$. This concluſion may be conſidered as a demonſtration of what is called the rule of three in arithmetic.

2. If four quantities be ſuch that the product of two of them is equal to the product of the other two, theſe quantities are proportionals.

Let a, b, c, d, be the quantities, which are ſuch that $ad=bc$, if theſe equals be divided by bd, we get $\frac{ad}{bd}=\frac{bc}{bd}$ or $\frac{a}{b}=\frac{c}{d}$, hence it follows, from the definition given of proportionals, (§ 97.) that $a:b::c:d$. From this property of proportionals it appears, that if three quantities be ſuch that the ſquare of one of them be equal to the product of the other two, theſe quantities are three proportionals.

101. If four quantities are proportional, that is, if $a:b::c:d$, then will each of the following combinations or arrangements of the quantities be alſo four proportionals.

1ſt, By inverſion $b:a::d:c$
2d, By alternation $a:c::b:d$ *
3d, By compoſition $a+b:a::c+d:c$
or $a+b:b::c+d:d$
4th, By diviſion $a-b:a::c-d:c$
or $a-b:b::c-d:d$
5th, By mixing $a+b:a-b::c+d:c-d$
6th, By taking any equimultiples of the antecedents, and alſo any equimultiples of the conſequents
$na:pb::nc:pd$
7th, Or by taking any parts of the antecedents and conſequents $\frac{a}{n}:\frac{b}{p}::\frac{c}{n}:\frac{d}{p}$.

That the preceding combinations of the quantities a, b, c, d are proportionals, may be readily proved, by taking the products of the extremes and means; for from each of them we derive this concluſion, that $ad=bc$, which is known to be true, from the original aſſumption of the quantities.

102. If four quantities be proportional, and alſo other four, the product of the correſponding terms will be proportional.

Let $a:b::c:d$,
and $e:f::g:h$,
Then $ae:bf::cg:dh$.

For $ad=bc$ and $eh=fg$ (§ 100.), therefore, multiplying together theſe equal quantities $adeh=bcfg$, or $ae\times dh=bf\times cg$, therefore by the ſecond property (§ 100.), $ae:bf::cg:dh$.

103. Hence it follows, that if there be any number of proportions whatever, the products of the correſponding terms will ſtill be proportional.

104. If a ſeries of quantities be ſo related to each other, that the quotient ariſing from the diviſion of any term by that which follows it is always the ſame quantity, theſe quantities are ſaid to be in *continued geometrical proportion*, ſuch are the numbers 2, 4, 8, 16, 32, &c. alſo $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, &c. and in general a ſeries of ſuch quantities may be repreſented thus, a, ar, ar^2, ar^3, ar^4, ar^5, &c. Here a is the firſt term, and r the quotient of any two adjoining terms, which is alſo called the *common ratio*.

105. By inſpecting this ſeries we find that it has the following properties:

1. The laſt term is equal to the firſt, multiplied by the common ratio raiſed to a power, the index of which is one leſs than the number of terms. Therefore if z denote the laſt term, and n the number of terms, $z=ar^{n-1}$.

2. The

* The quantities in this caſe muſt be all of the ſame kind, that is, if a and b denote ſurfaces, then c and d muſt alſo denote ſurfaces, but they cannot repreſent lines, &c.

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2. The product of the first and last term is equal to the product of any two terms equally distant from them: thus, supposing ar^5 the last term, it is evident that $a\times ar^5=ar\times ar^4=ar^2\times ar^3$, &c.

106. The sum of all the terms may be found thus: let s represent that sum, then, supposing the number of terms to be six, $s=a+ar+ar^2+ar^3+ar^4+ar^5$, and multiplying these equals by r, $sr=ar+ar^2+ar^3+ar^4+ar^5+ar^6$. If from the lower line, or $sr=ar+ar^2+\ldots+ar^6$, we subtract the upper line, or $s=a+ar+\ldots+ar^5$, the remainders will evidently be equal; but on the one side of the sign $=$ we have $sr-s$, and on the other ar^6-a: therefore, $sr-s=ar^6-a$, and dividing by $r-1$, $s=\frac{ar^6-a}{r-1}$. Let us now, instead of 6, substitute n (for the number of terms put down was 6), and we have the following general rule for finding the sum of a series of quantities in continued geometrical proportion, $s=\frac{ar^n-a}{r-1}$, or $s=\frac{a(r^n-1)}{r-1}$.

Sect. VI. *Of the Reduction of Equations involving one unknown quantity.*

107. The general object of algebraic investigation is to discover certain unknown quantities, by comparing them with other quantities which are given, or supposed to be known. The relation between the known and unknown quantities is either that of equality, or else such as may be reduced to equality; and a proposition which affirms that certain combinations of quantities are equal to one another is called an *equation*. Such are the following, $\frac{x}{2}+\frac{x}{3}=\frac{24}{x}$, $2x+3y=xy$; the first of these equations expresses the relation between an unknown quantity x, and certain known numbers; and the second expresses the relation which the two indefinite quantities x and y have to each other.

108. When a quantity stands alone on one side of an equation, the terms on the other side are said to be a *value* of that quantity. Thus in the equation $x=ay+b-c$, the quantity x stands alone on one side, and $ay+b-c$ is its value.

109. The conditions of a problem may be such as to require several equations and symbols of unknown quantities for their complete expression; these, however, by rules hereafter to be explained, may be reduced to one equation, involving only one unknown quantity and its powers, besides the known quantities; and the method of expressing that quantity, by means of the known quantities, constitutes the theory of equations, one of the most important, as well as most intricate branches of algebraic analysis.

110. An equation is said to be *resolved*, when the unknown quantity is made to stand alone on one side, and only known quantities on the other side; and the value of the unknown quantity is called a *root* of the equation.

111. Equations containing only one unknown quantity and its powers, are divided into different *orders*, according to the highest power of that quantity contained in any one of its terms. The equation, however, is supposed to be reduced to such a form, that the unknown quantity is found only in the numerators of the terms, and that the exponents of its powers are expressed by positive integers.

112. If an equation contains only the first power of the unknown quantity, it is called a *simple* equation, or an equation of the first order. Such is $ax+b=c$, where x denotes an unknown, and a, b, c known quantities.

113. If the equation contains the second power of the unknown quantity, it is said to be of the second degree, or is called a *quadratic* equation; such is $4x^2+3x=12$, and in general $ax^2+bx=c$. If it contains the third power of the unknown quantity, it is of the third degree, or is a *cubic* equation. Such are $x^3-2x^2+4x=10$, and $ax^3+bx^2+cx=d$, and so on, with respect to equations of the higher orders. A simple equation is sometimes said to be *linear*, or to be of one *dimension*. In like manner, quadratic equations are said to be equations of two dimensions, and cubic equations to be of three dimensions.

114. When in the course of an algebraic investigation we arrive at an equation involving only one unknown quantity, that quantity will often be so entangled in the different terms, as to render several previous reductions necessary before the equation can be expressed under its characteristic form, so as to be resolved by the rules which belong to that form.

These reductions depend upon the operations which have been explained in the former part of this treatise, and the application of a few self-evident principles, namely, that if equal quantities be added to, or subtracted from equal quantities, the sums or remainders will be equal; if equal quantities be multiplied, or divided by the same quantity, the products or quotients will be equal; and, lastly, if equal quantities be raised to the same power, or have the same root extracted out of each, the results will still be equal.

From these considerations are derived the following rules, which apply alike to equations of all orders, and are alone sufficient for the resolution of simple equations.

115. *Rule* 1. Any quantity may be transposed from one side of an equation to the other, by changing its signs.

Thus, if $x-3=5$
Then $x=5+3$
Or $x=8$
And if $3x-10=2x+5$
Then $3x-2x=5+10$
Or $x=15$
Again, if $ax+b=cx-dx+e$
Then $ax-cx+dx=e-b$
Or $(a-c+d)x=e-b$

The reason of this rule is evident, for the transposing a quantity from one side of an equation to the other is nothing more than adding the same quantity to each side of the equation, if the sign of the quantity transposed was $-$; or subtracting it, if the sign was $+$.

From this rule we may infer, that if any quantity be found on each side of the equation with the same sign, it may be left out of both. Also, that the signs of all the terms of an equation may be changed into the

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the contrary without affecting the truth of the equation.

Thus, if $a+x=b+a-c$

Then $x=b+c$

And if $a-x=b-d$

Then $x-a=d-b$

116. *Rule.* 2. If the unknown quantity in an equation be multiplied by any quantity, that quantity may be taken away, by dividing all the other terms of the equation by it.

If $3x=24$

Then $x=\frac{24}{3}=8$

If $ax=b-c$

Then $x=\frac{b-c}{a}=\frac{b}{a}-\frac{c}{a}$.

Here equal quantities are divided by the same quantity, and therefore the quotients are equal.

117. *Rule* 3. If any term of an equation be a fraction, its denominator may be taken away by multiplying all the other terms of the equation by that denominator.

If $\frac{x}{5}=7$

Then $x=35$

If $\frac{x}{a}=b-c+d$

Then $x=ab-ac+ad$

If $a-\frac{b}{x}=c$,

$ax-b=cx$.

In these examples, equal quantities are multiplied by the same quantity, and therefore the products are equal.

118. The denominators may be taken away from several terms of an equation by one operation, if we multiply all the terms by any number which is a multiple of each of these denominators.

Thus, if $\frac{x}{2}+\frac{x}{3}+\frac{x}{4}=26$.

Let all the terms be multiplied by 12, which is a multiple of 2, 3, and 4, and we have

$$\frac{12x}{2}+\frac{12x}{3}+\frac{12x}{4}=312$$

Or $6x+4x+3x=312$

Hence $13x=312$

Universally, if $\frac{x}{a}-\frac{x}{b}+\frac{x}{c}=d-e$.

To take away the denominators a, b, c, let the whole equation be multiplied by $a\,b\,c$, their product, and we have

$$bcx-acx+abx=abc(d-e)$$

Or $(bc-ac+ab)x=abc(d-e)$.

119. From the two last rules it appears that if all the terms of an equation be either multiplied or divided by the same quantity, that quantity may be left out of all the terms.

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If $ax=ab-ac$

Then $x=b-c$

And if $\frac{x}{a}=\frac{b}{a}+\frac{c}{a}$

Then $x=b+c$.

120. *Rule.* If the unknown quantity is found in any term which is a surd, let that surd be made to stand alone on one side of the equation, and the remaining terms on the opposite side; then involve each side to a power denoted by the index of the surd, and thus the unknown quantity shall be freed from the surd expression.

If $\sqrt{x}+6=10$

Then by transposition $\sqrt{x}=10-6=4$

And squaring both sides $\sqrt{x}\times\sqrt{x}=4\times4$

Or $x=16$.

Also, if $\sqrt{a^2+x^2}-b=x$

By transf. $\sqrt{a^2+x^2}=b+x$

And squaring, $a^2+x^2=(b+x)^2=b^2+2bx+x^2$

Hence $a^2=b^2+2bx$.

And if $\sqrt[3]{a^2x-b^2x}=a$

Then $a^2x-b^2x=a^3$.

121. *Rule* 5. If the side of the equation, which contains the unknown quantity, be a perfect power, the equation may be reduced to another of a lower order, by extracting the root of that power out of each side of the equation.

Thus if $x^3=64a^3$

Then, by extracting the cube root, $x=8a$

And if $(a+x)^2=b^2-a^2$

Then $a+x=\sqrt{b^2-a^2}$

122. The use of the preceding rules will be farther illustrated by the following examples:

Ex. 1. Let $20-3x-8=60-7x$

By rule 1. $7x-3x=60+8-20$

Or $4x=48$

Therefore by rule 2. $x=12$.

Ex. 2. Let $ax-b=cx+d$

By rule 1. $ax-cx=b+d$

Or $(a-c)x=b+d$

And by rule 2. $x=\frac{b+d}{a-c}$.

Ex. 3. Let $\frac{x+1}{2}+\frac{x+2}{3}=16-\frac{x+3}{4}$

By rule 3. $\begin{cases} x+1+\frac{2x+4}{3}=32-\frac{2x+6}{4} \\ 3x+3+2x+4=96-\frac{6x+18}{4} \\ 12x+12+8x+16=384-6x-18 \end{cases}$

Or $20x+28=366-6x$

Hence, by rule 1. $26x=338$

And by rule 2. $x=13$.

In this example, instead of taking away the denominators one after another, they might have been all taken away at once, by multiplying the given equation by by 12, which is divisible by the numbers 2, 3, and 4; thus we should have got $6x+6+4x+8=192-3x-9$, and hence, as before, $x=13$.

Ex. 4. Let $6x^3-20x^2=16x^2+2x^3$

Then dividing by $2x^2$, $3x-10=8+x$
And transposing, $3x-x=8+10$
Or $2x=18$
And therefore $x=9$.

Ex. 5. Let $a-\frac{b^2}{x}=c$

Then $ax-b^2=cx$
And $ax-cx=b^2$
Whence $x=\frac{b^2}{a-c}$.

Ex. 6. Let $x-6=\frac{x^2}{x+24}$.

Then $(x-6)(x+24)=x^2$
That is $x^2+18x-144=x^2$
Therefore $18x=144$
And $x=8$.

Ex. 7. Let $ax+b^2=\frac{ax^2+ac^2}{a+x}$

Then $(a+x)(ax+b^2)=ax^2+ac^2$
Or $a^2x+ab^2+ax^2+b^2x=ax^2+ac^2$
Hence $a^2x+b^2x=ac^2-ab^2$
And $x=\frac{ac^2-ab^2}{a^2+b^2}$.

Ex. 8. Let $\frac{1-x}{1+x}=a$

Then $1-x=a+ax$
And $-x-ax=a-1$
Or changing the signs, $x+ax=1-a$
Hence, $x=\frac{1-a}{1+a}$.

Ex. 9. Let $\sqrt{12+x}=2+\sqrt{x}$.

Then by rule 4. $12+x=4+4\sqrt{x}+x$
And by transposition $8=4\sqrt{x}$
And by division $2=\sqrt{x}$
And again by rule 4. $4=x$.

Ex. 10. Let $x+\sqrt{a^2+x^2}=\frac{2a^2}{\sqrt{a^2+x^2}}$

Then, by rule 3. $x\sqrt{a^2+x^2}+a^2+x^2=2a^2$
And by transposition, &c. $x\sqrt{a^2+x^2}=a^2-x^2$
Therefore, by rule 4. $a^2x^2+x^4=a^4-2a^2x^2+x^4$
Whence $3a^2x^2=a^4$
And $x^2=\frac{a^2}{3}$, therefore, rule 5. $x=\frac{a}{\sqrt{3}}$.

Ex. 11. Let $\frac{1-\sqrt{1-x^2}}{1+\sqrt{1-x^2}}=a$

Then $1-\sqrt{1-x^2}=a+a\sqrt{1-x^2}$
And $1-a=a\sqrt{1-x^2}+\sqrt{1-x^2}=(1+a)\sqrt{1-x^2}$
Whence $\frac{1-a}{1+a}=\sqrt{1-x^2}$
And, taking the square of both sides, $\frac{(1-a)^2}{(1+a)^2}=1-x^2$
Therefore, by transposition, $x^2=1-\frac{(1-a)^2}{(1+a)^2}$
That is, $x^2=\frac{(1+a)^2-(1-a)^2}{(1+a)^2}=\frac{4a}{(1+a)^2}$
Therefore $x=\frac{2\sqrt{a}}{1+a}$.

Ex. 12. Let $a+x=\sqrt{a^2+x\sqrt{b^2+x^2}}$

Then $(a+x)^2=a^2+x\sqrt{b^2+x^2}$
That is, $a^2+2ax+x^2=a^2+x\sqrt{b^2+x^2}$
Therefore $2ax+x^2=x\sqrt{b^2+x^2}$
And dividing by x, $2a+x=\sqrt{b^2+x^2}$
Again taking the squares of both sides, $4a^2+4ax+x^2=b^2+x^2$
Whence $4a^2+4ax=b^2$
And $4ax=b^2-4a^2$; so that $x=\frac{b^2-4a^2}{4a}$.

123. In all these examples we have been able to determine the value of the unknown quantity by the rules already delivered, because in every case the first, or at most the second power of that quantity, has been made to stand alone on one side of the equation, while the other consisted only of known quantities; but the same methods of reduction serve to bring equations of all degrees to a proper form for solution. Thus if $\frac{1-p+q+r}{x+1}=1-p-x+\frac{r}{x}$; by proper reduction, we have $x^3+px^2+qx=r$, a cubic equation, which may be resolved by rules to be afterwards explained.

Sect. VII. *Of the Reduction of Equations involving more than one unknown quantity.*

124. Having shown in the last section in what manner an equation involving one unknown quantity may be resolved, or at least fitted for a final solution, we are next to explain the methods by which two or more equations, involving as many unknown quantities, may at last be reduced to one equation, and one unknown quantity.

As the unknown quantities may be combined together in very different ways, so as to constitute an equation, the methods most proper for their extermination must therefore be various. The three following, however, are of general application, and the last of them may be used with advantage, not only when the unknown quantity to be exterminated arises to the same power in all the equations, but also when the equations contain different powers of that quantity.

125. *Method* 1. Observe which of the unknown quantities is the least involved, and let its value be found from each equation by the rules of last section.

Let the values thus found be put equal to each other, and hence new equations will arise, from which that

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that quantity is wholly excluded. Let the same operation be now repeated with the new equations, and the unknown quantities exterminated one by one, till at last an equation be found, which contains only one unknown quantity.

Ex. Let it be required to determine x and y from these two equations.

$$2x+3y=23$$
$$5x-2y=10$$

From the first equation $2x=23-3y$

And $x=\frac{23-3y}{2}$

From the second equation $5x=10+2y$

And $x=\frac{10+2y}{5}$

Let these values of x be now put equal to each other.

And we have $\frac{10+2y}{5}=\frac{23-3y}{2}$

Or $20+4y=115-15y$

Therefore $19y=95$

And $y=5$

And since $x=\frac{23-3y}{2}$, or $x=\frac{10+2y}{5}$, from either of these values we find $x=4$.

126. *Method* 2. Let the value of the unknown quantity, which is to be exterminated, be found from that equation wherein it is least involved. Let this value, and its powers, be substituted for that quantity, and its respective powers in the other equations; and with the new equations thus arising, let the operation be repeated, till there remain only one equation, and one unknown quantity.

Ex. Let the given equations, as in last method, be

$$2x+3y=23$$
$$5x-2y=10$$

From the first equation $x=\frac{23-3y}{2}$

And this value of x being substituted in the second equation, we have $5\times\frac{23-3y}{2}-2y=10$

Or $115-15y-4y=20$

Therefore $95=19y$

And $5=y$

And hence $x=\frac{23-3y}{2}=4$, as before.

127. *Method* 3. Let the given equations be multiplied or divided by such numbers or quantities, whether known or unknown, that the term which involves the highest power of the unknown quantity may be the same in each equation.

Then by adding or subtracting the equations, as occasion may require, that term will vanish, and a new equation emerge, wherein the number of dimensions of the unknown quantity in some cases, and in others the number of unknown quantities, will be diminished; and by a repetition of the same, or similar operations, a final equation may be at last obtained, involving only one unknown quantity.

Ex. Let the same example be taken, as in the illustration of the two former methods, namely,

$$2x+3y=23$$
$$5x-2y=10$$

and from these two equations we are to determine x and y. To exterminate x, let the first equation be multiplied by 5, and the second by 2, thus we have

$$10x+15y=115$$
$$10x-\ \ 4y=\ \ 20$$

Here the term involving x is the same in both equations, and it is obvious that by subtracting the one from the other, the resulting equation will contain only y, and known numbers, for by such subtraction we find $19y=95$, and therefore $y=5$.

Having got the value of y, it is easy to see how x may be found, from either of the given equations; but it may also be found in the same manner as we found y. For let the first of the given equations be multiplied by 2, and the second by 3, and we have

$$4x+6y=46$$
$$15x-6y=30$$

By adding these equations, we find

$$19x=76$$

and therefore $x=4$

128. The following examples will serve farther to illustrate these different methods of exterminating the unknown quantities from equations.

Ex. 1. Given $\left\{\begin{array}{l}\frac{x}{2}+\frac{y}{3}=16\\ \frac{x}{5}-\frac{y}{9}=\ 2\end{array}\right\}$ Required x and y.

By Method 1.

From the first equation we find $x=32-\frac{2y}{3}$

And from the second $x=10+\frac{5y}{9}$

Therefore $10+\frac{5y}{9}=32-\frac{2y}{3}$

Or $90+5y=288-6y$

Hence $11y=198$

And $y=18$

The value of y being substituted in either of the values of x, namely, $32-\frac{2y}{3}$ or $10+\frac{5y}{9}$ we find $x=20$.

By Method 2.

Having found from the first given equation $x=32-\frac{2y}{3}$, let this value of x be substituted in the second, thus we have

$$\frac{1}{5}\left(32-\frac{2y}{3}\right)-\frac{y}{9}=2$$

Or $\frac{32}{5}-\frac{2y}{15}-\frac{y}{9}=2$

Hence $198=11y$

And $18=y$

The

The value of y being now ſubſtituted in either of the given equations, we thence find $x=20$ as before.

By Method 3.

The denominators of the two given equations being taken away by rule 3. of laſt ſection, we have

$$3x+2y=96$$
$$9x-5y=90$$

From three times the firſt of theſe equations, or $9x+6y=288$, let the ſecond be ſubtracted, and there remains

$$11y=198$$

And hence $\quad y=18$

The value of y being now ſubſtituted in either of the equations $3x+2y=96$, $9x-5y=90$, we readily find $x=20$.

129. Having now ſhewn in what manner the different methods of exterminating the unknown quantities may be applied, we ſhall, in the remaining examples of this ſection, chiefly make uſe of the laſt method, becauſe it is the moſt eaſy and expeditious in practice.

Ex. 2. Given $\left\{\begin{array}{l} \frac{x}{2}-12=\frac{y}{4}+8 \\ \frac{x+y}{5}+\frac{x}{3}-8=\frac{2y-x}{4}+27 \end{array}\right\}$

It is required to determine x and y.

From the 1ſt equation we have $4x-96=2y+64$.

And from the ſecond, $12x+12y+20x-480=30y-15x+1620$.

Theſe two equations when abridged become

$$4x-2y=160$$
$$47x-18y=2100$$

To exterminate y; from this laſt equation let 9 times the one preceding it be ſubſtracted.

Thus we find $\quad 11x=660$

And $\quad x=60$

And becauſe $\quad 2y=4x-160=80$

Therefore $\quad y=40$.

Ex. 3. Given $\left\{\begin{array}{l} ax+by=c \\ dx+fy=g \end{array}\right\}$ To determine x and y.

To exterminate y, let the firſt equation be multiplied by f and the ſecond by b; and we have

$$afx+bfy=cf$$
$$bdx+bfy=bg$$

Taking now the difference between theſe equations we find

$$afx-bdx=cf-bg$$

Or $\quad (af-bd)x=cf-bg$

And therefore $\quad x=\frac{cf-bg}{af-bd}$.

In the ſame manner may y be determined, by multiplying the firſt of the given equations by d, and the ſecond by a; for we find

$$adx+bdy=cd$$
$$adx+afy=ag$$

and taking the difference as before, we get

$$bdy-afy=cd-ag$$

And therefore $\quad y=\frac{cd-ag}{bd-af}$.

This laſt example may be conſidered as a general ſolution of the following problem. Two equations expreſſing the relation between the firſt powers of two unknown quantities being given, to determine thoſe quantities. For whatever be the number of terms in each equation, it will readily appear, as in example 2d, that by proper reduction, they may be brought to the ſame form as thoſe given in the 3d example.

130. Let us next conſider ſuch equations as involve three unknown quantities.

Ex. 4. Given $\left\{\begin{array}{l} x+y+z=29 \\ x+2y+3z=62 \\ \frac{x}{2}+\frac{y}{3}+\frac{z}{4}=10 \end{array}\right\}$ To find x, y, and z.

We ſhall in this example proceed according to the rules of the firſt method for exterminating the unknown quantities.

From the firſt equation $\quad x=29-y-z$

From the ſecond $\quad x=62-2y-3z$

From the third $\quad x=20-\frac{2y}{3}-\frac{z}{2}$.

Let theſe values of x be put equal to each other, thus we get the two following equations.

$$29-y-z=62-2y-3z$$
$$29-y-z=20-\frac{2y}{3}-\frac{z}{2}.$$

Again, from theſe two equations, by tranſpoſition, &c. we find

$$y=33-2z$$
$$y=27-\frac{3z}{2}$$

Therefore $\quad 33-2z=27-\frac{3z}{2}$

And hence, by reduction $\quad z=12$

Whence alſo $\quad y=33-2z=9$

And $\quad x=29-y-z=8$.

Ex. 5. Given $\left\{\begin{array}{l} \frac{x}{2}+\frac{y}{3}+\frac{z}{4}=62 \\ \frac{x}{3}+\frac{y}{4}+\frac{z}{5}=47 \\ \frac{x}{4}+\frac{y}{5}+\frac{z}{6}=38 \end{array}\right\}$ To find x, y, and z.

Here the given equations, when cleared from fractions, become

$$12x+8y+6z=1488$$
$$20x+15y+12z=2820$$
$$30x+24y+20z=4560.$$

To exterminate z by the third method, let the firſt equation be multiplied by 10, the ſecond by 5, and the third by 3, the reſults will be theſe:

$$120x+80y+60z=14880$$
$$100x+75y+60z=14100$$
$$90x+72y+60z=13680$$

Let

Let the ſecond equation be now ſubſtracted from the firſt, and the third from the ſecond, and we have

$$20x+5y=780$$
$$10x+3y=420$$

Next to exterminate y, let the firſt of theſe equations be multiplied by 3, and the ſecond by 5, hence

$$60x+15y=2340$$
$$50x+15y=2100$$

Subtracting now the latter equation from the former.

$$10x=240$$

Hence $x=24$

Therefore $y=\frac{420-10x}{3}=60$

And $z=\frac{1448-12x-8y}{6}=120.$

131. From the preceding examples, it is manifeſt in what manner any number of unknown quantities may be determined, by an equal number of equations, which contain only the firſt power of thoſe quantities, in the numerators of the terms. Such are the following

$$ax+by+cz=n$$
$$dx+ey+fz=p$$
$$gx+hy+kz=q$$

where a, b, c, &c. repreſent known, and x, y, z, unknown quantities; and in every caſe of this kind, the unknown quantities may be directly found, for they will be always expreſſed by whole numbers, or rational fractions, provided that the known quantities a, b, c, &c. are alſo rational.

132. We ſhall now add a few examples, in which the equations that reſult from the extermination of an unknown quantity ariſe to ſome of the higher degrees; and therefore their final ſolution muſt be referred to the ſections which treat of thoſe degrees.

Ex. 6. Let $x-y=2$, and $xy+5x-6y=120$; it is required to exterminate x.

From the firſt equation $x=y+2$; which value being ſubſtituted in the other equation according to the ſecond general method (§ 126) it becomes

$$(y+2)y+5(y+2)-6y=120$$

that is $y^2+2y+5y+10-6y=120$

therefore the equation required is $y^2+y=110$.

Ex. 7. There is given $x+y=a$, and $x^2+y^2=b$ to exterminate x.

From the firſt equation $x=a-y$, and $x^2=(a-y)^2$. And from the ſecond $x^2=b-y^2$.

Therefore $(a-y)^2=b-y^2$

That is $a^2-2ay+y^2=b-y^2$

Hence $2y^2-2ay=b-a^2$; an equation involving only y.

Ex. 8. Given $\left\{\begin{array}{l} axy+bx+cy=d \\ fxy+gx+hy=k \end{array}\right\}$ To exterminate y.

From the firſt equation we find $y=\frac{d-bx}{ax+c}$.

And from the ſecond $y=\frac{k-gx}{fx+h}$

Therefore $\frac{d-bx}{ax+c}=\frac{k-gx}{fx+h}$, an equation in which the unknown quantity y is not found.

Ex. 9. Given $\left\{\begin{array}{l} y^2-3xy+ay=x^2 \\ y^2+2ax-by=4x^2-b^2 \end{array}\right\}$ To exterminate y.

As the coefficient of y^2 is unity in both equations, if their difference be taken the higheſt power of y will vaniſh; but to give a general ſolution, let the terms of the equations be brought all to one ſide and made equal to 0, thus,

$$y^2-(3x+a)y-x^2=0$$
$$y^2-by+2ax-4x^2+b^2=0$$

Let us in the firſt equation put $1=A$, $-(3x+a)=B$, $-x^2=C$; and in the ſecond, $1=D$, $-b=E$, $2ax-4x^2+b^2=F$ and the two equations become

$$Ay^2+By+C=0$$
$$Dy^2+Ey+F=0$$

To exterminate y^2, let the firſt equation be multiplied by D, and the ſecond by A, and we have

$$ADy^2+BDy+CD=0$$
$$ADy^2+AEy+AF=0$$

Therefore, taking the difference of theſe equations,

$$(BD-AE)y+CD-AF=0$$

And $y=\frac{AF-CD}{BD-AE}$

Again, to find another value of y, multiply the firſt equation by F, and the ſecond by C, then

$$AFy^2+BFy+CF=0$$
$$CDy^2+CEy+CF=0$$

Therefore, ſubtracting as before, we get

$$(AF-CD)y^2+(BF-CE)y=0,$$

And dividing by y $(AF-CD)y+BF-CE=0,$

Therefore, $y=\frac{CE-BF}{AF-CD}$.

Let this value of y be put equal to the former value, thus we have $\frac{AF-CD}{BD-AE}=\frac{CE-BF}{AF-CD}$,

And therefore $(AF-CD)^2=(BD-AE)(CE-BF)$.

Now as y does not enter this equation, if we reſtore the values of A, B, C, &c. we have the following equation which involves only x, and known quantities. $(b^2+2ax-3x^2)^2=(a+b-3x)(bx^2-(a-3x)(2ax-4x^2+b^2))$; this equation when properly reduced will be of the fourth order, and therefore its final reſolution belongs not to this place.

SECT. VIII. *Queſtions producing Simple Equations.*

133. When a problem is propoſed to be reſolved by the algebraic method of analyſis, its true meaning ought in the firſt place to be perfectly underſtood, ſo that, if neceſſary, it may be freed from all ſuperfluous and ambiguous expreſſions; and its conditions exhibited in the cleareſt point of view poſſible. The ſeveral quantities concerned in the problem are next to be denoted by proper ſymbols, and their relations to one another expreſſed agreeably to the algebraic notation. Thus

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Thus we ſhall obtain a ſeries of equations, which, if the queſtion be properly limited, will enable us to determine all the unknown quantities required by the rules already delivered in the two preceding ſections.

134. In reducing the conditions of a problem to equations, the following rule will be of ſervice. Suppoſe that the quantities to be determined are actually found, and then conſider by what operations the truth of the ſolution may be verified; then, let the ſame operations be performed upon the quantities, whether known or unknown, and thus all the conditions of the problem will be reduced to a ſeries of equations, ſuch as is required. For example; ſuppoſe that it is required to find two numbers, ſuch, that their ſum is 20, and the quotient ariſing from the diviſion of their difference by the leſſer 3; then if we denote the greater of the two numbers by x, and the leſſer by y, and proceed as if to prove the truth of the ſolution, we ſhall have $x+y$ for the ſum of the numbers, and $x-y$ for their difference. Now as the former muſt be equal to 20, and the latter divided by y equal to 3; the firſt condition of the problem will be expreſſed by this equation $x+y=20$, and the ſecond by $\frac{x-y}{y}=3$, and from theſe, the values of x and y may eaſily be found.

135. When the conditions of a problem have been expreſſed by equations, or as it were tranſlated from the common language into that of algebra; we muſt next conſider, whether the problem be properly limited; for in ſome caſes, the conditions may be ſuch as to admit of innumerable ſolutions; and in others, they may involve an abſurdity; and thus render the problem altogether impoſſible.

136. Now by conſidering the examples of laſt ſection, it will readily appear, that to determine any number of unknown quantities, there muſt be given as many equations, as there are unknown quantities. Theſe equations, however, muſt be ſuch as cannot be derived from each other; and they muſt not involve any contradiction; for, in the one caſe, the problem would admit of an unlimited number of anſwers; and in the other caſe, it would be impoſſible. For example, if it were required to determine x and y from theſe two equations, $2x-3y=13$, $4x-6y=26$; as the latter equation is a conſequence of the former (for each term of the one is the half of the correſponding term of the other) it is evident, that innumerable values of x and y might be found to ſatiſfy both equations. Again, if x and y were to be determined from theſe equations, $x+2y=8$, $3x+6y=26$, it will quickly appear, that it is impoſſible to find ſuch values of x and y, as will ſatiſfy both equations; for from the firſt of them, we find $3x=24-6y$; and from the ſecond, $3x=26-6y$; and therefore $24-6y=26-6y$, or $24=26$, which is abſurd; and ſo alſo muſt have been the conditions from which this concluſion is drawn.

137. But there is yet another caſe in which a problem may be impoſſible; and that is, when there are more equations than unknown quantities; for it appears, that in this caſe, by the rules of laſt ſection, we would at laſt find two equations, each involving the ſame unknown quantity. Now unleſs theſe equations happened to agree, the problem would admit of no ſolution. Upon the whole, therefore, it appears, that a problem is limited, when the conditions afford juſt as many independent equations, as there are unknown quantities to be determined; if there be fewer equations the problem is indeterminate; but if there be more, the problem in general admits of no ſolution whatever.

138. In expreſſing the conditions of a problem by equations, it will, in general, be convenient to introduce as few ſymbols of unknown quantities as poſſible. Therefore, if two quantities be ſought and their ſum be given, ſuppoſe it $=s$, then if the one quantity be repreſented by x, the other may be denoted by $s-x$. If again their difference be given $=d$, the quantities may be denoted by x, and $d+x$, or by x, and $x-d$. If their product be given $=p$, the quantities are x, and $\frac{p}{x}$; and ſo on.

139. We ſhall now apply the preceding obſervations to ſome examples, which are ſo choſen as to admit of being reſolved by ſimple equations.

Ex. 1. What is that number, to which if there be added its half, its third, and its fourth part, the ſum will be 50.

Let x denote the number ſought. Then its half will be $\frac{x}{2}$, its third $\frac{x}{3}$ and its fourth $\frac{x}{4}$.

Therefore $x+\frac{x}{2}+\frac{x}{3}+\frac{x}{4}=50$.

Hence we find $24x+12x+8x+6x=1200$
Or $50x=1200$.
Therefore $x=24$.

Thus it appears, that the number ſought is 24, which upon trial will be found to anſwer the conditions of the queſtion.

Ex. 2. A poſt is $\frac{1}{4}$ of its length in the mud, $\frac{1}{3}$ in the water, and 10 feet above the water, what is its whole length?

Let its length be x feet, then the part in the mud is $\frac{x}{4}$, and that in the water $\frac{x}{3}$; therefore, from the nature of the queſtion

$$\frac{x}{4}+\frac{x}{3}+10=x.$$

From which equation we find $7x+120=12x$, and $x=24$.

Ex. 3. Two travellers ſet out at the ſame time from London and York, whoſe diſtance is 150 miles; one of them goes 8 miles a day, and the other 7; in what time will they meet?

Suppoſe that they meet after x days.

Then the one traveller has gone $8x$ miles, and the other $7x$ miles; now the ſum of the diſtances they travel is, by the queſtion, equal to the diſtance from London to York.

Therefore $8x+7x=150$
That is $15x=150$, and $x=10$ days.

Ex. 4. A labourer engaged to ſerve for 40 days, upon theſe conditions; that for every day he worked he was to receive 20d. but for every day he played, or was abſent, he was to forfeit 8d.; now at the end of

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of the time he had to received 1l. 11s. 8d. It is required to find how many days he worked, and how many days he was idle.

Let x be the number of days he worked.
Then will $40-x$ be the number of days he was idle.
Alſo $20\times x=20x=$ the ſum he earned, in pence.
And $8\times(40-x)=320-8x=$ the ſum he forfeited.
Now the difference of theſe two was 1l. 11s. 8d. or 380d.

Therefore $20x-(320-8x)=380$
That is $28x=700$
Hence $x=25=$ the number of days he worked.
And $40-x=15=$ the number of days he was idle.

Ex. 5. A market woman bought a certain number of eggs at 2 a-penny, and as many at 3 a-penny; and ſold them all out again at 5 for 2d.; but inſtead of getting her own money for them, as ſhe expected, ſhe loſt 4d.: what number of eggs did ſhe buy?

Let x be the number of eggs of each ſort.

Then will $\frac{x}{2}$ be the price of the firſt ſort,

And $\frac{x}{3}=$ the price of the ſecond ſort.

Now the whole number being $2x$, we have

$5:2x::2:\frac{4x}{5}=$ price of both ſorts at 5 for 2d.

Therefore $\frac{x}{2}+\frac{x}{3}-\frac{4x}{5}=4$, by the queſtion.

Hence $15x+10x-24x=120$,
And $x=120$, the number of each ſort.

Ex. 6. A bill of 120l. was paid in guineas and moidores; the number of pieces of both ſorts that were uſed was 100; how many were there of each?

Let the number of guineas be x.
Then the number of moidores will be $100-x$.
Alſo the value of the guineas, reckoned in ſhillings, will be $21x$; and that of the moidores $27(100-x)=2700-27x$.
Therefore, by the queſtion, $21x+2700-27x=2400$.
Hence we find $6x=300$ and $x=50$.
So that the number of pieces of each ſort was 50.

Ex. 7. A footman agreed to ſerve his maſter for 8l. a-year, and livery; but was turned away at the end of 7 months, and received only 2l. 13s. 4d. and his livery; what was its value?

Suppoſe x the value of the livery, in pence.
Then his wages for a year were to be $x+1920$ pence.
But for 7 months he received $x+640$ pence.
Now he was paid in proportion to the time he ſerved.

Therefore $\overset{m}{12}:\overset{m}{7}::x+1920:x+640$
And taking the product of the extremes, and means.
$12x+7680=7x+13440$.
Hence $5x=5760$d. and $x=1152$d.$=$4l. 16s.

Ex. 8. A perſon at play loſt $\frac{1}{4}$ of his money, and then won 3 ſhillings; after which he loſt $\frac{1}{3}$ of what he then had; and then won 2 ſhillings; laſtly, he loſt $\frac{1}{7}$ of what he then had; and this done, found he had only 12 ſhillings left; what had he at firſt?

Suppoſe he began play with x ſhillings.

He loſt $\frac{1}{4}$ of his money, or $\frac{x}{4}$, and had left $x-\frac{x}{4}=\frac{3x}{4}$.

He won 3s. and had then $\frac{3x}{4}+3=\frac{3x+12}{4}$.

He loſt $\frac{1}{3}$ of $\frac{3x+12}{4}$, or $\frac{x+4}{4}$, and had left $\frac{3x+12}{4}-\frac{x+4}{4}=\frac{2x+8}{4}$.

He won 2s. and had then $\frac{2x+8}{4}+2=\frac{2x+16}{4}$.

He loſt $\frac{1}{7}$ of $\frac{2x+16}{4}$ or $\frac{2x+16}{28}$, and had left $\frac{2x+16}{4}-\frac{2x+16}{28}=\frac{12x+96}{28}$.

And becauſe he had now 12s. left, we have this equation $\frac{12x+96}{28}=12$.

Hence $12x=240$ and $x=20$.

Ex. 9. Two tradeſmen A and B are employed upon a piece of work, A can perform it alone in 15 hours, and B in 10 hours; in what time will they do it when working together.

Suppoſe that they can do it in x hours, and let the whole work be denoted by 1.

Then $\overset{h}{15}:\overset{h}{x}::1:\frac{x}{15}=$ the part of the work done by A.

And $\overset{h}{10}:\overset{h}{x}::1:\frac{x}{10}=$ the part done by B.

Now by the queſtion, they are to perform the whole work between them;

Therefore, $\frac{x}{15}+\frac{x}{10}=1$,

Hence $25x=150$ and $x=6$ hours.

Ex. 10. The ſum of any two quantities being given $=s$, and their difference$=d$, it is required to find each of the quantities.

Let x denote the greater of the two quantities, and y the leſſer
Then $x+y=s$, and $x-y=d$
Taking the ſum of the equations we get $2x=s+d$
And ſubtracting the ſecond from the firſt, $2y=s-d$
Therefore $x=\frac{s+d}{2}$ and $y=\frac{s-d}{2}$.

Ex. 11. A gentleman diſtributing money among ſome poor people, found he wanted 10s. to be able to give each 5s. therefore he gave only 4s. to each, and had 5s. left. Required the number of ſhillings and poor people.

Let the number of ſhillings be x, and that of the poor people y, then from the nature of the queſtion we have theſe two equations.

$5y=x+10 \qquad 4y=x-5$
From the firſt equation, $x=5y-10$,
And from the ſecond, $x=4y+5$
Therefore $5y-10=4y+5$
Hence $y=15$, and $x=4y+5=65$.

Ex.

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Ex. 12. A farmer kept a ſervant for every 40 acres of ground he rented, and on taking a leaſe of 104 more acres, he engaged 5 additional ſervants, after which he had a ſervant for every 36 acres. Required the number of ſervants and acres.

Suppoſe that he had at firſt x ſervants, and y acres.

From the firſt condition of the queſtion $x=\frac{y}{40}$

And from the ſecond $x+5=\frac{y+104}{36}$

By comparing the values of x, as found from theſe equations, we have $\frac{y+104}{36}-5=\frac{y}{40}$.

Hence $40y+4160-7200=36y$, ſo that $4y=3040$,

Therefore $y=760$, and $x=\frac{y}{40}=19$.

Ex. 13. Two perſons, A and B, were talking of their ages; ſays A to B, ſeven years ago I was juſt three times as old as you were then, and ſeven years hence I ſhall be juſt twice as old as you will be. What is their preſent ages?

Let the ages of A and B be x and y reſpectively. Their ages ſeven years ago were $x-7$ and $y-7$, and ſeven years hence they will be $x+7$ and $y+7$.

Therefore by the queſtion

$$x-7=3(y-7) \text{ and } x+7=2(y+7).$$

From the firſt equation, $x=3y-14$,

And from the ſecond $x=2y+7$.

Therefore $3y-14=2y+7$; hence $y=21$.

And becauſe $x=2y+7$, therefore $x=49$.

Ex. 14. A hare is 50 leaps before a greyhound, and takes 4 leaps to the greyhound's 3, but 2 of the greyhound's leaps are as much as 3 of the hare's. How many leaps muſt the greyhound take to catch the hare?

In this example there is only one quantity required, it will, however, be convenient to make uſe of two letters; therefore let x denote the number of leaps of the greyhound, and y thoſe of the hare; then, by conſidering the proportion between the number of leaps each takes in the ſame time, we have

$$3:4::x:y, \text{ hence } 3y=4x.$$

Again, by conſidering the proportion between the number of leaps each muſt take to run the ſame diſtance, we find $x:50+y::2:3$, hence $100+2y=3x$.

From the firſt equation we find $6y=8x$,

And from the ſecond $6y=9x-300$,

Hence $9x-300=8x$, and $x=300$.

Ex. 15. To divide the number 90 into 4 ſuch parts, that if the firſt be increaſed by 2, the ſecond diminiſhed by 2, the third multiplied by 2, and the fourth divided by 2; the ſum, difference, product, and quotient, ſhall be all equal to each other.

In this queſtion there are four quantities to be determined; but inſtead of introducing ſeveral letters, having put x to denote the firſt of them, we may find an expreſſion for each of the remaining ones, as follows:

Becauſe $x+2=$ ſecond quantity -2,

Therefore $x+4=$ the ſecond quantity.

And becauſe $x+2=$ third $\times 2$,

Therefore $\frac{x+2}{2}=$ the third quantity.

And in like manner $2(x+2)=$ the fourth quantity,

Now by the queſtion, the ſum of all the four $=90$,

Therefore $x+x+4+\frac{x+2}{2}+2(x+2)=90$;

Hence $9x=162$, and $x=18$.

Therefore the numbers required are 18, 22, 10, and 40.

Ex. 16. A and B together can perform a piece of work in 12 hours, A and C in 20, and B and C in 15 hours; in what time will each be able to perform it when working ſeparately?

That we may give a general ſolution, let us ſuppoſe A and B can perform the work in a hours, A and C in b hours, and B and C in c hours. Let x, y, and z, denote the times in which A, B, and C, could perform it reſpectively, if each wrought alone; and let the whole work be repreſented by 1.

H H

Then $x:a::1:\frac{a}{x}=$ the part done by A, $y:a::1:\frac{a}{y}=$ the part done by B, in a hours.

Alſo $x:b::1:\frac{b}{x}=$ the part done by A, $z:b::1:\frac{b}{z}=$ the part done by C, in b hours.

And $y:c::1:\frac{c}{y}=$ the part done by B, $z:c::1:\frac{c}{z}=$ the part done by C, in c hours.

Now by the queſtion we have the three following equations.

$$\frac{a}{x}+\frac{a}{y}=1,\ \frac{b}{x}+\frac{b}{z}=1,\ \frac{c}{y}+\frac{c}{z}=1.$$

Let the firſt equation be divided by a, the ſecond by b, and the third by c, thus we have

$$\frac{1}{x}+\frac{1}{y}=\frac{1}{a},\ \frac{1}{x}+\frac{1}{z}=\frac{1}{b},\ \frac{1}{y}+\frac{1}{z}=\frac{1}{c}.$$

If theſe be added together, and their ſum divided by 2, we find

$$\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=\frac{1}{2a}+\frac{1}{2b}+\frac{1}{2c}.$$

From this equation let each of the three laſt be ſubtracted in its turn; thus we get

$$\frac{1}{z}=-\frac{1}{2a}+\frac{1}{2b}+\frac{1}{2c}=\frac{+ab+ac-bc}{2abc}$$

$$\frac{1}{y}=\frac{1}{2a}-\frac{1}{2b}+\frac{1}{2c}=\frac{abc-ac+bc}{2abc}$$

$$\frac{1}{x}=\frac{1}{2a}+\frac{1}{2b}-\frac{1}{2c}=\frac{-ab+ac+bc}{2abc}$$

Hence $z=\frac{2abc}{+ab+ac-bc}=\frac{7200}{120}=60$

$$y=\frac{2abc}{+ab-ac+bc}=\frac{7200}{360}=20$$

$$x=\frac{2abc}{-ab+ac+bc}=\frac{7200}{240}=30.$$

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Quadratic Equations.

Sect. IX. *Of Quadratic Equations.*

140. We are next to explain the manner of resolving equations of the second degree, or quadratic equations. These involve the second power of the unknown quantity, as has been already observed (§ 113.) and may be divided into two kinds, *pure* and *adfected.*

141. I. *Pure* quadratic equations are such as after proper reduction have the square of the unknown quantity in one term, while the remaining terms contain only known quantities. Thus, $x^2=64$, and $ax^2+b=c$ are examples of pure quadratics.

142. II. *Adfected* quadratic equations, contain the square of the unknown quantity in one term, and its first or simple power in another, and the remaining terms consist entirely of known quantities. Such are the following, $x^2+3x=28$, $2x^2=33-5x$, $ax^2+bx-c=d$.

143. The manner of resolving a pure quadratic equation is sufficiently evident; if the unknown quantity be made to stand alone on one side, with unity as a coefficient, while the other side consists entirely of known quantities, and if the square root of each side be taken, we shall immediately obtain the value of the simple power of the unknown quantity as already directed by Rule 5th of Sect. VI.

144. In extracting the square root of any quantity, however, it is necessary to observe, that the sign of the root may be either $+$ or $-$. This is an evident consequence of the rule for the signs in multiplication; for since by that rule any quantity, whether positive or negative, if multiplied by itself, will produce a positive quantity, and therefore the square of $+a$, as well as that of $-a$ is $+a^2$; so on the contrary, the square root of $+a^2$ is to be considered either as $+a$ or as $-a$, and may accordingly be expressed thus $\pm a$.

145. Having remarked that the square of any quantity whatever be its sign, is always positive; it evidently follows, that no real quantity whatever, when multiplied by itself, can produce a negative quantity; and therefore, if the square root of a negative quantity be required, no such root can be assigned. Hence it also follows, that if a problem requires for its solution the extraction of the square root of a negative quantity, some contradiction must necessarily be involved, either in the conditions of the problem, or in the process of reasoning by which that solution has been obtained.

146. When an adfected quadratic equation is to be resolved, it may always, by proper reduction, be brought to one or other of the three following forms.

1. $x^2+px=q$
2. $x^2-px=q$
3. $x^2-px=-q$

But as the manner of resolving each of the three forms is the very same, it will be sufficient if we consider any one of them.

147. Resuming therefore the first equation, or $x^2+px=q$; let us compare the side of it which involves the unknown quantity x with the square of a binomial $x+a$; that is, let us compare x^2+px with $x^2+2ax+a^2=(x+a)^2$; and it will presently appear, that if we suppose $p=2a$, or $\frac{p}{2}=a$, the quantities x^2+px and x^2+2ax will be equal; and as x^2+2ax is rendered a complete square, by adding to it a^2, so also may x^2+px be completed into a square, by adding to it $\frac{p^2}{4}$, which is equal to a^2; therefore, let $\frac{p^2}{4}$ be added to both sides of the equation $x^2+px=q$, and we have

$$x^2+px+\frac{p^2}{4}=\frac{p^2}{4}+q,\text{ or }\left(x+\frac{p}{2}\right)^2=\frac{p^2}{4}+q;$$

and extracting the square root of each side, $x+\frac{p}{2}=\pm\sqrt{\frac{p^2}{4}+q}$; hence $x=-\frac{p}{2}\pm\sqrt{\frac{p^2}{4}+q}$.

148. From these observations, we derive the following general rule for resolving adfected quadratic equations.

1. Transpose all the terms involving the unknown quantity to one side, and the known quantities to the other side, and so that the term involving the square of the unknown quantity may be positive.

2. If the square of the unknown quantity be multiplied by a coefficient, let all the other terms be divided by it, so that the coefficient of the square of the unknown quantity may be 1.

3. Add to both sides the square of half the coefficient of the unknown quantity itself, and the side of the equation involving the unknown quantity will now be a complete square.

4. Extract the square root of both sides of the equation, by which it becomes simple with respect to the unknown quantity; and, by transposition, that quantity may be made to stand alone on one side of the equation, while the other side consists of known quantities; and therefore the equation is resolved.

Note. The square root of the first side of the equation is always equal to the sum, or difference of the unknown quantity, and half the coefficient of the second term. If the sign of that term be $+$, it is equal to the sum, but if it be $-$, then it is equal to the difference.

Ex. 1. Given $x^2+2x=35$, to determine x.

Here the coefficient of the second term is 2, therefore, adding the square of its half to each side, we have

$$x^2+2x+1=35+1=36$$

And extracting the square root $x+1=\sqrt{36}=\pm6$

Hence $x=\pm6-1$, that is $x=+5$, or $x=-7$, and either of these numbers will be found to satisfy the equation for $5\times5+2\times5=35$, also $-7\times-7+2\times-7=35$.

Ex. 2. Given $\frac{x^2}{6}-12=x$ to find x.

This equation, when reduced, becomes $x^2-6x=72$.

And by completing the square, $x^2-6x+9=72+9=81$.

Hence, by extracting the square root, $x-3=\pm9$.

And $x=\pm9+3$, therefore $x=+12$, or $x=-6$, and upon trial we find that each of these values satisfies

Quadratic Equations.

fies the original equation; for $\frac{12\times 12}{6}-12=12$, alſo $\frac{6\times -6}{6}-12=-6$.

Ex. 3. Given $x^2+28=11x$, to find x.

Then $x^2-11x=-28$.

And, completing the ſquare, $x^2-11x+\frac{121}{4}=\frac{121}{4}-28=\frac{9}{4}$

Therefore, by extracting the root, $x-\frac{11}{2}=\pm\frac{3}{2}$

Hence $x=\frac{11}{2}\pm\frac{3}{2}$, that is $x=+7$, or $x=+4$.

In the firſt two examples, we found one poſitive value for x in each, and alſo one negative value, but in this example both the values of x are poſitive, and upon trial each of them is found to ſatisfy the equation; for $7\times 7+28=11\times 7$, alſo $4\times 4+28=11\times 4$.

149. As at firſt ſight it appears remarkable, that in every quadratic equation the unknown quantity admits always of two diſtinct values, or roots, it will be proper to conſider a little farther the circumſtances upon which this peculiarity depends. This is the more neceſſary, as the property of the unknown quantity admitting of ſeveral values is not peculiar to quadratics, but takes place alſo in equations of the higher degrees, where the cauſe of the ambiguity requires an explanation ſomewhat different from that which we have already given in the preſent caſe.

150. Let us again conſider the equation $x^2+2x=35$, which forms the firſt of the three preceding examples; by tranſpoſing all the terms to one ſide, the ſame equation may be alſo expreſſed thus, $x^2+2x-35=0$; ſo that we ſhall have determined x, when we have found ſuch a number, as when ſubſtituted for it in the quantity $x^2+2x-35$ will render the reſult equal to 0. But $x^2+2x-35$ is the product of theſe two factors $x-5$, and $x+7$, as may be proved by actual multiplication; therefore to find x we have $(x-5)(x+7)=0$; and as a product can only become $=0$, when one of its factors is reduced to 0, it follows, that either of the two factors $x-5$ and $x+7$ may be aſſumed $=0$; if $x-5=0$, then $x=5$; but if $x+7=0$, then $x=-7$, ſo that the two values of x, or two roots of the equation $x^2+2x=35$ are $+5$ and -7, as we have already found in a different manner.

151. What has been juſt now ſhewn in a particular caſe is true of any quadratic equation whatever, that is, if $x^2+px=q$, or by bringing all the terms to one ſide, $x^2+px-q=0$, it is always poſſible to find two factors $x+a$, and $x-b$, ſuch, that $x^2+px-q=(x+a)(x-b)$, where a and b are known quantities which depend only upon p and q the given numbers in the equation, and ſince that to have $(x-a)(x+b)=0$, we may either aſſume $x-a=0$, or $x+b=0$, it evidently follows that the conditions of the equation $x^2+px-q=0$, or $x^2+px=q$ are alike ſatisfied by taking $x=+a$ or $x=-b$.

From theſe conſiderations, it follows, that x can have only two values in a quadratic equation; for if it could be ſuppoſed to have three, or more values, then it would be poſſible to reſolve x^2+px-q into as many factors; $x-c$, $x-d$, &c. but the product of more than two factors muſt neceſſarily contain the third or higher powers of x; and as x^2+px-q contains no higher power than the ſecond, therefore no ſuch reſolution can take place.

152. Since it appears that x^2+px-q may be conſidered as the product of two factors $x-a$, and $x+b$, let us examine the nature of theſe factors; accordingly, taking their product by actual multiplication, we find it $x^2+(b-a)x-ab$; and ſince this quantity muſt be equal to x^2+px-q, it follows, that $b-a=p$ and $ab=q$, or, changing the ſigns of the terms of both equations, $a-b=-p$, $-ab=-q$. Now if we conſider that $+a$, and $-b$ are the roots of the equation $x^2+px=q$; it is evident that $a-b$ is the ſum of the roots, and $-ab$ their product. So that from the equations $a-b=-p$, and $-ab=q$, we derive the following propoſition relating to the roots of any quadratic equation. The ſum of the roots of any quadratic equation $x^2+px=q$ is equal to $-p$, that is to the coefficient of the ſecond term, having its ſign changed; and their product is equal to $-q$, or to the latter ſide of the equation, having its ſign alſo changed.

153. This propoſition enables us to reſolve ſeveral important queſtions concerning the roots of a quadratic equation, without actually reſolving that equation. Thus we learn from it, that if q, the term which does not involve the unknown quantity (called ſometimes the abſolute number) be poſitive, the equation has one of its roots poſitive, and the other negative; but if that term be negative, the roots are either both poſitive or both negative. It alſo follows, that in the former caſe the root which is denoted by the leaſt number will have the ſame ſign with the ſecond term, and in the latter caſe, the common ſign of the roots will be the contrary to that of the ſecond term.

154. From this property of the roots we may alſo derive a general ſolution to any quadratic equation $x^2+px=q$; for we have only to determine two quantities whoſe ſum is $-p$, and product $-q$, and theſe quantities ſhall be the two values of x, or the two roots of the equation.

Without conſidering the ſigns of the roots, let us call them v and z, then

$$v+z=-p \text{ and } vz=-q$$

From the ſquare of each ſide of the firſt equation let four times the ſecond be ſubtracted and we have

$$v^2-2vz+z^2=p^2+4q, \text{ or } (v-z)^2=p^2+4q,$$

therefore, by extracting the ſquare root, $v-z=\pm\sqrt{p^2+4q}$; from this equation, and from the equation $v+z=p$, we readily obtain $v=\frac{-p\pm\sqrt{p^2+4q}}{2}$ $z=\frac{-p\mp\sqrt{p^2+4q}}{2}$, that is, if $v=\frac{-p+\sqrt{p^2+4q}}{2}$, then $z=-\frac{p-\sqrt{p^2+4q}}{2}$, and if $v=-\frac{p-\sqrt{p^2+4q}}{2}$, then $z=\frac{-p+\sqrt{p^2+4q}}{2}$.

But the value of v, upon the one ſuppoſition, is the ſame as the value of z upon the other ſuppoſition, and *vice verſa*, therefore in reality the only two diſtinct

vice

values of the roots v and z are $\frac{-p+\sqrt{p^2+4q}}{2}$ and $\frac{-p-\sqrt{p^2+4q}}{2}$, which agrees with the concluſion we have already found, (§ 148.)

155. It appears from what has been already ſhewn, that the roots of a quadratic equation $x^2+px=q$ always involve the quantity $\sqrt{p^2+4q}$; hence it follows, that p^2+4q muſt be a poſitive quantity; for if it were negative, as the ſquare root of ſuch a quantity could not be found, the value of x could not poſſibly be obtained. If for example the value of x were required from this equation $x^2+13=4x$, or $x^2-4x=-13$, we ſhould find $x=2\pm\sqrt{-9}$; and as this expreſſion for the roots requires us to extract the ſquare root of -9, the equation from which it is derived muſt neceſſarily have involved ſome contradiction. It is not difficult to ſee wherein the abſurdity conſiſts, for ſince in this caſe $p=-4$, and $q=-13$, the roots of the equation ought to be both poſitive (§ 154), and ſuch that their ſum $=4$, while their product $=13$, (§ 153), which is impoſſible.

156. Although imaginary quantities ſerve no other purpoſe in the reſolution of quadratic equations, than to ſhew that a particular problem cannot be reſolved, by reaſon of ſome want of conſiſtency in its data; yet they are not upon that account to be altogether rejected. By introducing them into mathematical inveſtigations, many curious theories may be explained, and problems reſolved in a more conciſe way, than can be done without the uſe of ſuch quantities. This is particularly the caſe with reſpect to the higher parts of the mathematics.

157. The method which has been applied to the reſolution of quadratic equations, properly ſo called, namely, ſuch as are of this form $x^2+px=q$, will alſo apply to all equations of this form,

$$x^{2n}+px^n=q.$$

Where the unknown quantity x is found only in two terms, and ſuch, that its exponent in the one term is double that in the other; for let us aſſume $x^n=y$, then $x^{2n}=y^2$, and therefore the equation

$$+x^{2n}+px^n=q \text{ becomes}$$
$$y^2+py=q.$$

a quadratic equation, from which y may be found, and thence x, by conſidering that $x=\sqrt[n]{y}$.

158. Before proceeding to give examples of queſtions producing quadratic equations, it is proper to obſerve, that although every ſuch equation admits of two roots; yet it will frequently happen, that only one of them can be of uſe, the other being excluded by the conditions of the queſtion. This will often be the caſe with reſpect to the negative root; as for example, when the unknown quantity denotes a number of men, a number of days, &c. And hence, in reckoning the caſes of quadratic equations, it is common to neglect this one $x^2+px=-q$, where the roots are both negative; for an equation of this form can only be derived from a queſtion which has ſome fault in its enunciation, and which, by a proper change in its form, will produce another equation having both its roots poſitive.

159. The remainder of this ſection ſhall be employed in ſolving ſome queſtions which produce quadratic equations.

Ex. 1. It is required to divide the number 10 into two ſuch parts, that the ſum of their ſquares may be 58.

Let x be the one number.

Then, ſince their ſum is 10, we have $10-x$ for the other.

And by the queſtion $x^2+(10-x)^2=58$

That is $x^2+100-20x+x^2=58$

Or $2x^2-20x=58-100=-42$

Hence $x^2-10x=-21$

And completing the ſquare $x^2-10x+25=25-21=4$

Hence, by extracting the root, $x-5=\pm\sqrt{4}=\pm 2.$

And $x=5\pm 2=7$

That is $x=7$ or $x=3$.

If we take the greateſt value of x, viz. 7, then the other number $10-x$ will be 3; and if we take the leaſt value of x, viz. 3, then the other number is 7. Thus it appears, that the greateſt value of the one number correſponds to the leaſt value of the other; and indeed this muſt neceſſarily be the caſe, ſeeing that both numbers are alike concerned in the queſtion. Hence upon the whole, the only numbers that will anſwer the conditions of the queſtion are 7 and 3.

Ex. 2. What two numbers are thoſe whoſe product is 28; and ſuch, that twice the greater, together with thrice the leſſer is equal to 26.

Let x be the greateſt and y the leaſt number, then, from the nature of the queſtion, we have theſe two equations

$$xy=28, \quad 2x+3y=26.$$

From the firſt equation we have $y=\frac{28}{x}$.

And from the ſecond $y=\frac{26-2x}{3}$.

Hence, $\frac{26-2x}{3}=\frac{28}{x}$.

And, reducing, $26x-2x^2=84$

Or $2x^2-26x=-84$

Hence $x^2-13x=-42$

And comp. the ſq. $x^2-13x+\frac{169}{4}=\frac{169}{4}-42=\frac{1}{4}$

Hence, by extracting the root $x-\frac{13}{2}=\pm\sqrt{\frac{1}{4}}=\pm\frac{1}{2}$

Therefore $x=\frac{13}{2}\pm\frac{1}{2}$

That is $x=7$, or $x=6$.

And ſince $y=\frac{28}{x}$, we have $y=4$, or $y=\frac{14}{3}$.

Thus we have obtained two ſets of numbers, which fulfil the conditions required, viz.

$$x=7,\ y=4 : \text{Or } x=6,\ y=\tfrac{14}{3}.$$

And beſides theſe, there can be no other numbers.

Ex. 3. A company dining together at an inn, find their bill amount to 175 ſhillings; two of them were not allowed to pay, and the reſt found, that their ſhares amounted to 10 ſhilligs a-man more than if they had all paid. How many were in company?

Suppoſe their number to be x.

Then, if all had paid, the ſhare of each would have been $\frac{175}{x}$.

But,

But, becaufe only $x-2$ paid, the fhare of each was $\frac{175}{x-2}$.

Therefore, by the queftion, $\frac{175}{x-2}-\frac{175}{x}=10$.

And by proper reduction $175x-175x+350=10x^2-20$.

That is $10x^2-20x=350$

Or $x^2-2x=35$

And comp. the fq. $x^2-2x+1=35+1=36$

Hence, by extracting the root, $x^2+1=\pm 6$.

Therefore, $x=+5$, or $x=-7$. But from the nature of the queftion, the negative root can be of no ufe; therefore $x=6$.

Ex. 4. A mercer fold a piece of cloth for 24l. and gained as much *per cent* as the cloth coft him; what was the price of the cloth?

Suppofe that it coft x pounds,

Then the gain was $24-x$,

And by the queftion $100 : x :: x : 24-x$,

Therefore, taking the product of the extremes and means, $2400-100x=x^2$,

Or $x^2+100x=2400$,

And comp. the fq. $x^2+100x+2500=4900$,

Hence, taking the root, $x+50=\pm 70$,

And $x=+20$ or -120.

Here, as in the laft queftion, the negative root cannot apply; therefore $x=20$ pounds, the price required.

Ex. 5. A grazier bought as many fheep as coft him 60l. out of which he referved 15, and fold the remainder for 54l. and gained 2s. each upon them. How many fheep did he buy, and what did each coft him?

Suppofe that he bought x fheep,

Then each would coft him $\frac{1200}{x}$ fhillings.

Therefore, after referving 15, he fold each of the remaining $x-15$ for $\frac{1200}{x}+2$ fhillings,

Hence, he would receive for them $(x-15)(\frac{1200}{x}+2)$ fhillings. And, becaufe $54\text{l.}=1080$ fhillings, we have by the queftion $(x-15)(\frac{1200}{x}+2)=1080$.

Which by proper reduction becomes $x^2+45x=9000$.

Or, completing the fquare, $x^2+45x+\frac{2025}{4}=\frac{38025}{4}$.

Therefore, extracting the root, &c. $x=\pm\frac{195}{2}-\frac{45}{2}$.

And taking the pofitive root, $x=75$, the number of fheep; and confequently $\frac{1200}{75}=16$ fhillings the price of each.

Ex. 6. What number is that, which, when divided by the product of its two digits, the quotient is 3; and if 18 be added to it, the digits are inverted. Let x and y denote the digits; then the number itfelf will be expreffed by $10x+y$; and that number, in which the digits are inverted, by $10y+x$. Thus the conditions of the problem will be expreffed by thefe two equations,

$$\frac{10x+y}{xy}=3,\quad 10x+y+18=10y+x$$

From the firft equation we have $y=\frac{10x}{3x-1}$

And from the fecond $y=x+2$

Therefore $x+2=\frac{10x}{3x-1}$

And $3x^2+5x-2=10x$

Hence $x^2-\frac{5}{3}x=\frac{2}{3}$

And comp. fq. $x^2-\frac{5}{3}x+\frac{25}{36}=\frac{25}{36}+\frac{2}{3}=\frac{49}{36}$

Therefore, taking the root $x-\frac{5}{6}=\pm\frac{7}{6}$

So that $x=2$, or $x=-\frac{1}{3}$

Here it is evident that the negative root is ufelefs; hence we have $y=x+2=4$, and 24 for the number required.

Ex. 7. It is required to find two numbers whofe product is 100; and the difference of their fquare roots 3.

Let x be the one number; then $\frac{100}{x}$ muft denote the other.

Now by the queftion $\frac{10}{\sqrt{x}}-\sqrt{x}=3$

Hence we have $10-x=3\sqrt{x}=3x^{\frac{1}{2}}$

Or $x+3x^{\frac{1}{2}}=10$

And comp. the fq. $x+3x^{\frac{1}{2}}+\frac{9}{4}=10+\frac{9}{4}=\frac{49}{4}$

and taking the root $x^{\frac{1}{2}}+\frac{3}{2}=\pm\frac{7}{2}$

So that $x^{\frac{1}{2}}=+5$ or $x^{\frac{1}{2}}=-2$

and therefore $x=25$ or $x=4$.

If $x=4$, the other number is $\frac{100}{4}=25$, and if $x=25$, then the other number is 4; fo that, in either cafe, the two numbers which anfwer the conditions of the queftion are 4 and 25.

Ex. 8. It is required to find two numbers, of which the product fhall be 6, and the fum of their cubes 35.

Let x be the one number, then $\frac{6}{x}$ will be the other.

Therefore, by the queftion, $x^3+\frac{216}{x^3}=35$

Hence $x^6+216=35x^3$

Or $x^6-35x^3=-216$

This equation, by putting $x^3=y$, becomes $y^2-35y=-216$

Hence we find $y=27$, or $y=8$.

And fince $x^3=y$; therefore $x=3$, or $x=2$.

If $x=3$, then the other number is 2, and if $x=2$, the other number is 3; fo that 2 and 3 are the numbers required.

In general, if it be required to find two numbers, which are exactly alike concerned in a queftion that produces a quadratic equation; the two numbers fought will be the roots of that equation. A fimilar obfervation applies to any number of quantities which require for the determination the refolution of an equation of any degree whatever.

SECT. X. *Of Equations in General.*

160. BEFORE we proceed to the refolution of cubic, and the higher orders of equations, it will be proper to

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to explain ſome general properties, which belong to equations of every degree; and alſo certain operations, which muſt frequently be performed upon equations, before they be fitted for a final ſolution.

161. In treating of equations in general, we ſhall ſuppoſe all the terms tranſpoſed to one ſide, and put equal to 0; this we have already done in explaining the nature of quadratics, and in like manner an equation of the fourth degree will ſtand thus:

$$x^4+px^3+qx^2+rx+s=0,$$

where x denotes an unknown quantity, and p, q, r, s, known quantities, either poſitive or negative. In this equation the coefficient of the higheſt power of x is unity, but if it had been any other quantity, that quantity might have been taken away, and the equation reduced to the above form, by rules already explained, Sect. VI.

162. The terms of an equation being thus arranged, if ſuch a quantity be found, as when ſubſtituted for x, will render both ſides $=0$, and therefore ſatisfy the equation, that quantity whether it be poſitive or negative, or even imaginary, is to be conſidered as a root of the equation. But we have ſeen that every quadratic equation has always two roots, real or imaginary, we may therefore ſuppoſe that a ſimilar diverſity of roots will take place in all equations of a higher degree; and this ſuppoſition we ſhall preſently find to be well founded, by means of the following propoſition which is of great importance in the theory of equations.

If a root of any equation, as $x^4+px^3+qx+r=0$, be repreſented by a, the firſt ſide of that equation is diviſible by $x-a$.

For ſince $x^4+px^3+qx^2+rx+s=0$
And alſo $a^4+pa^3+qa+ra+s=0$
Therefore, by ſubtraction, $x^4-a^4+p(x^3-a^3)+q(x^2-a^2)+r(x-a)=0$.

163. But any quantity of this form x^n-a^n, where n denotes a whole poſitive number, is equal to

$$(x-a)(x^{n-1}+ax^{n-2}+a^2x^{n-3}+\ldots+a^{n-2}x+a^{n-1}),$$

as may be eaſily proved by multiplication; therefore, putting $x=4$, 3 and 2 ſucceſſively, we have

$$\begin{aligned}x^4-a^4&=(x-a)(x^3+ax^2+a^2x+a^3)\\ x^3-a^3&=(x-a)(x^2+ax+a^2)\\ x^2-a^2&=(x-a)(x+a)\\ x-a&=x-a\end{aligned}$$

and by ſubſtitution, and collecting into one term, the coefficients of the like powers of x, the equation

$x^4-a^4+p(x^3-a^3)+q(x^2-a^2)+r(x-a)=0$ becomes $(x-a)[x^3+(a+p)x^2+(a^2+pa+q)x+a^3+pa^2+qa+r]=0$, ſo that putting $p'=a+p$, $q'=a^2+pa+q$, $r'=a^3+pa^2+qa+r$, we have

$$x^4+px^3+qx^2+rx+s=(x-a)(x^3+p'x^2+q'x+r')$$

Hence, if the propoſed equation $x^4+px^3+qx^2+rx+s$ be divided by $x-a$, the quotient will be $x^3+p'x^2+q'x+r'$, an integer quantity, and ſince the ſame mode of reaſoning will apply to any equation whatever; the truth of the propoſition is evident.

164. We have found that $(x-a)(x^3+p'x^2+q'x+r')=0$, and as a product becomes $=0$, when any one of its factors $=0$, therefore, the equation will have

its conditions fulfilled, not only when $x-a=0$, but alſo when $x^3+p'x^2+q'x+r'=0$.

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Let us now ſuppoſe that b is a root of this equation, then by reaſoning exactly as in laſt article, and putting $p''=b+p'$, $q''=b^2+p'b+q'$, we ſhall have

$$x^3+p'x^2+q'x+r'=(x-b)(x^2+p''x+q'')=0$$

and therefore

$$x^4+px^3+qx^2+rx+s=(x-a)(x-b)(x^2+p''x+q'').$$

165. By proceeding in the ſame manner with the quadratic equation $x^2+p''x+q''=0$, we ſhall find that if c denote one of its roots, then

$$x^2+p''x+q''=(x-c)(x+c+p'')$$

So that if we put $d=-(c+p'')$, we at laſt find $x^4+px^3+qx^2+rx+s=(x-a)(x-b)(x-c)(x-d)$; and ſince each of the factors $x-a$, $x-b$, $x-c$, $x-d$ may be aſſumed $=0$; it follows, that there are four different values of x, which will render the equation $x^4+px^3+qx^2+rx+s=0$, namely, $x=a$, $x=b$, $x=c$, $x=d$.

166. The mode of reaſoning which has been juſt now employed in a particular caſe, may be applied to an equation of any order whatever; we may therefore conclude, that every equation may be conſidered as the product of as many ſimple factors, as the number denoting its order contains unity; and therefore, that the number of roots in any equation is preciſely equal to the exponent of the higheſt power of the unknown quantity contained in that equation.

167. By conſidering equations of all degrees as formed from the product of factors $x-a$, $x-b$, $x-c$, &c. we diſcover a number of curious relations, which ſubſiſt between the roots of any equation whatever, and its coefficients. Thus, if we limit the number of factors to four, and ſuppoſe that a, b, c, d, are the roots of this equation of the fourth degree

$$x^4+px^3+qx^2+rx+s=0$$

we ſhall alſo have $(x-a)(x-b)(x-c)(x-d)=0$; and therefore, by actual multiplication

$$x^4\left.\begin{matrix}-a\\-b\\-c\\-d\end{matrix}\right\}x^3\left.\begin{matrix}+ab\\+ac\\+ad\\+bc\\+bd\\+cd\end{matrix}\right\}x^2\left.\begin{matrix}-abc\\-abd\\-acd\\-bcd\end{matrix}\right\}x+abcd=0.$$

168. If we compare together the coefficients of the ſame powers of x, we find the following ſeries of equations:

$$\begin{aligned}a+b+c+d&=-p\\ ab+ac+ad+bc+bd+cd&=+q\\ abc+abd+acd+bcd&=-r\\ abcd&=+s\end{aligned}$$

and as a ſimilar ſeries of equations will be obtained for every equation whatever, we hence derive the following propoſitions, which are of the greateſt importance in the theory of equations.

1. The coefficient of the ſecond term of any equation taken with a contrary ſign, is equal to the ſum of all the roots.

2. The coefficient of the third term is equal to the ſum of the products of the roots multiplied together two and two.

3. The coefficient of the fourth term, taken with a contrary

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contrary sign, is equal to the sum of the roots multiplied together three and three, and so on for the remaining coefficients, till we come to the last term of the equation, which is equal to the product of all the roots, having their signs changed.

169. Instead of supposing an equation to be produced by multiplying together simple equations, we may consider it as formed by the product of equations of any degree, provided that the sum of their dimensions is equal to that of the proposed equation. Thus, an equation of the fourth degree may be formed either from a simple and cubic equation, or from two quadratic equations.

170. If n denote the degree of an equation, we have shewn, that by considering it as the product of simple factors, that equation will have n divisors of the first degree; but if we suppose the simple factors to be combined two and two, they will form quantities of the second degree, which are also factors of the equation; and since there may be formed $\frac{n(n-1)}{1.2}$ such combinations, any equation will admit of $\frac{n(n-1)}{1.2}$ divisors of the second degree.

171. For example, the equation $x^4+px^3+qx^2+rx+s=0$ which we have considered as equal to

$$(x-a)(x-b)(x-c)(x-d)=0$$

may be formed by the product of two factors of the second degree, in these six different ways.

By the product of $(x-a)(x-b)$ and $(x-c)(x-d)$
$(x-a)(x-c)$ $(x-b)(x-d)$
$(x-a)(x-d)$ $(x-b)(x-c)$
$(x-b)(x-c)$ $(x-a)(x-d)$
$(x-b)(x-d)$ $(x-a)(x-c)$
$(x-c)(x-d)$ $(x-a)(x-b)$

Thus an equation of the fourth degree may have $\frac{4\times 3}{1\times 2}=6$ quadratic divisors.

172. By combining the simple factors three and three, we shall have divisors of the third degree, of which the number for an equation of the nth order will be $\frac{n(n-1)(n-2)}{1.2.3}$; and so on.

173. When the roots of an equation are all positive, its simple factors will have this form $x-a$, $x-b$, $x-c$, &c. and if for the sake of brevity we take only these three, the cubic equation which results from their product will have this form

$$x^3-px^2+qx-r=0$$

where $p=a+b+c$, $q=ab+ac+bc$, $r=abc$, and here it appears that the signs of the terms are $+$ and $-$ alternately.

Hence we infer, that when the roots of an equation are all positive, the signs of its terms are positive and negative alternately.

174. If again the roots of the equation be all negative, and therefore its factors $x+a$, $x+b$, $x+c$, then p, q and r being as before, the resulting equation will stand thus:

$$x^3+px^2+qx+r=0.$$

And hence we conclude, that when the roots are all negative, there is no change whatever in the signs.

175. In general, if the roots of an equation be all real, that equation will have as many positive roots as there are changes of the signs from $+$ to $-$, or from $-$ to $+$; and the remaining roots are negative. This rule, however, does not apply when the equation has imaginary roots, unless such roots be considered as either positive or negative.

176. That the rule is true when applied to quadratic equations will be evident from Sect. IX. With respect to cubic equations, the rule also applies when the roots are either all positive, or all negative, as we have just now shewn.

When a cubic equation has one positive root, and the other two negative, its factors will be $x-a$, $x+b$, $x+c$, and the equation itself.

$$x^3\left.\begin{array}{l}-a\\+b\\+c\end{array}\right\}x^2\left.\begin{array}{l}-ab\\-ac\\+bc\end{array}\right\}x-abc=0.$$

Here there must always be one change of the signs, since the first term is positive, and the last negative; and there can be no more than one; for if the second term is negative, or $b+c$ less than a, then $(b+c)^2$ will be less than $(b+c)a$; but $(b+c)^2$ is always greater than bc, therefore bc will be much less than $(b+c)a$ or $ab+ac$, so that the third term must also be negative, and therefore in this case only one change of the signs. If again the second term be positive, then because the sign of the last term is negative, whatever be the sign of the third term, there can still be no more than one change of the signs.

When the equation has two positive roots and one negative, its factors are $x-a$, $x-b$, $x+c$, and the equation.

$$x^3\left.\begin{array}{l}-a\\-b\\+c\end{array}\right\}x^2\left.\begin{array}{l}+ab\\-ac\\-bc\end{array}\right\}x+abc=0.$$

Here there must always be two changes of the signs; for if $a+b$ be greater than c, the second term is negative, and the last term being always positive, there must be two changes, whether the sign of the third term be positive or negative. If again $a+b$ be less than c, and therefore the second term positive; it may be shewn as before, that ab is much less than $ac+bc$; and hence the third term will be negative; so that in either case there must be two changes of the signs. We may conclude therefore, upon the whole, that in cubic equations there are always as many positive roots, as changes of the signs from $+$ to $-$, or from $-$ to $+$; and by the same method of reasoning, the rule will be found to extend to all equations whatever.

177. It appears from the manner in which the coefficients of an equation are formed from its roots, that when the roots are all real, the coefficients must consist entirely of real quantities. But it does not follow, on the contrary, that when the coefficients are real, the roots are also real; for we have already found, that in a quadratic equation, $x^2+px+q=0$ where p and q denote real quantities, the roots are sometimes both imaginary.

178. When the roots of a quadratic equation are imaginary, they have always this form $a+\sqrt{-b^2}$, $a-\sqrt{-b^2}$, which quantities may also be expressed thus,

$a+b$

$a+b\sqrt{-1}$, $a-b\sqrt{-1}$, so that we have these two factors $x-a-b\sqrt{-1}$, $x-a+b\sqrt{-1}$, and taking their product,

$$x^2-2ax+a^2-b^2=0;$$

Thus we see that two imaginary factors may be of such a form as to admit of their product being expressed by a real quantity; and hence the origin of imaginary roots in quadratic equations.

179. It appears by induction, that no real equation can be formed from imaginary factors, unless those factors be taken in pairs, and each pair have the form $x\pm a-b\sqrt{-1}$, $x\pm a+b\sqrt{-1}$; for the product of three, or any odd number of imaginary factors, whatever be their form, is still an imaginary quantity. Thus, if we take the product of any three of these four imaginary expressions $x+a+b\sqrt{-1}$, $x+a-b\sqrt{-1}$, $x+c+d\sqrt{-1}$, $x+c-d\sqrt{-1}$ we may form four different equations, each of which will involve imaginary quantities. If, however, each equation be multiplied by the remaining factor, which had not previously entered into its composition, the product will be found to be rational, and the same for all the four.

180. Hence we may deduce the three following inferences respecting the roots of equations:

1. If an equation have imaginary roots, it must have two, or four, or some even number of such roots.

2. If the degree of an equation be denoted by an odd number, that equation must have at least one real root.

3. If the degree of an equation be denoted by an even number, and that equation have one real root, it will also have another real root.

181. We shall now explain some transformations which are frequently necessary to prepare the higher orders of equations for a solution.

Any equation may have its positive roots changed into negative roots of the same value, and its negative roots into such as are positive, by changing the signs of the terms alternately, beginning with the first. The truth of this remark will be evident, if we take two equations,

$$(x-a)(x-b)(x+c)=0$$
$$(x+a)(x+b)(x-c)=0,$$

(which are such, that the positive roots of the one have the same values as the negative roots of the other) and multiply together their respective factors, for these equations will stand thus:

$$\left.\begin{array}{r}x^3-a\\-b\\+c\end{array}\right\}x^2\left.\begin{array}{r}+ab\\-ac\\-bc\end{array}\right\}x+abc=0$$

$$\left.\begin{array}{r}x^3+a\\+b\\-c\end{array}\right\}x^2\left.\begin{array}{r}+ab\\-ac\\-bc\end{array}\right\}x-abc=0$$

where it appears that the signs of the first and third terms are the same in each, but the signs of the second and fourth are just the opposite of each other. And this will be found to hold true, not only of cubic equations, but of all equations to whatever order they belong.

182. It will sometimes be useful to transform an equation into another, that shall have each of its roots greater or less than the corresponding roots of the other equation, by some given quantity.

Let $(x-a)(x-b)(x+c)=0$ be any proposed equation which is to be transformed into another, having its roots greater or less than those of the proposed equation by the given quantity n; then, because the roots of the transformed equation are to be $+a\pm n$, $+b\pm n$ and $-c\pm n$, the equation itself will be

$$(y\mp n-a)(y\mp n-b)(y\mp n+c)=0.$$

Hence the reason of the following rule is evident.

If the new equation is to have its roots greater than those of the proposed equation, instead of x and its powers, substitute $y-n$ and its powers; but if the roots are to be less, then instead of x substitute $y+n$; and in either case, a new equation will be produced, the roots of which shall have the property required.

183. By means of the preceding rule, an equation may be changed into another, which has its roots either all positive, or all negative; but it is chiefly useful in preparing cubic and biquadratic equations for a solution, by transforming them into others of the same degrees, but which want their second term.

Let $x^3+px^2+qx+r=0$ be any cubic equation; if we substitute $y+n$ for x, the equation is changed into the following:

$$\left.\begin{array}{r}y^3+3n\\+p\end{array}\right\}y^2\left.\begin{array}{r}+3n^2\\+2pn\\+q\end{array}\right\}y\left.\begin{array}{r}+n^3\\+pn^2\\+qn\\+r\end{array}\right\}=0;$$

Now, that this equation may want its second term, it is evident, that we have only to suppose $3n+p=0$, or $n=-\frac{p}{3}$, for this assumption being made, and the value of n substituted in the remaining terms, the equation becomes

$$y^3 * +(q-\frac{p^2}{3})y+\frac{2p^3}{27}-\frac{pq}{3}+r=0,$$

or, putting $-\frac{p^2}{3}+q=q'$, and $+\frac{2p^3}{27}-\frac{pq}{3}+r=r'$ the same equation may also stand thus,

$$y^3+q'y+r'=0.$$

184. In general, any equation whatever may be transformed into another, which shall want its second term by the following rule.

Divide the coefficient of the second term of the proposed equation by the exponent of the first term, and add the quotient, with its sign changed, to a new unknown quantity; this sum being substituted for the unknown quantity in the proposed equation, a new equation will be produced, which will want the second term, as required.

185. By this rule, any adfected quadratic equation may be readily resolved; for by transforming it into another equation, which wants the second term, we thus reduce its solution to that of a pure quadratic. Thus if the quadratic equation $x^2-5x+6=0$ be proposed; by substituting $y+\frac{5}{2}$ for x, we find

$$\left.\begin{array}{r}y^2+5y+\frac{25}{4}\\-5y-\frac{25}{2}\\+6\end{array}\right\}=0 \text{ or } y^2-\tfrac{1}{4}=0,$$

Hence $y=\pm\frac{1}{2}$, and since $x=y+\frac{5}{2}$, therefore $x=\pm\frac{1}{2}+\frac{5}{2}=+3$ or $+2$.

186. It has been shewn (§ 169) that in any equation, the coefficient of the second term, having its sign changed, is equal to the sum of all the roots, or ab-

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ſtracting from their ſigns, it is equal to the difference between the ſum of the poſitive, and the ſum of the negative roots. Therefore, if the ſecond term be wanting, the ſum of the poſitive roots in that equation muſt neceſſarily be equal to that of the negative roots.

187. Inſtead of taking away the ſecond term from an equation, any other term may be made to vaniſh, by an aſſumption ſimilar to that which has been employed to take away the ſecond term. Thus if in § 183 we aſſume $3n^2+2pn+q=0$, by reſolving this quadratic equation, a value of n will be found, which when ſubſtituted in the equation, will cauſe the third term to vaniſh; and by the reſolution of a cubic equation the third term might be taken away; and ſo on.

188. Another ſpecies of transformation, of uſe in the reſolution of equations, is that by which an equation, having the coefficients of ſome of its terms expreſſed by fractional quantities, is changed into another, the coefficients of which are all integers.

Let $x^3+\frac{p}{a}x^2+\frac{q}{b}x+\frac{r}{c}=0$ denote an equation to be ſo transformed; and let us aſſume $y=abcx$; and therefore $x=\frac{y}{abc}$, then by ſubſtitution, our equation becomes

$$\frac{y^3}{a^3b^3c^3}+\frac{p}{a^3b^2c^2}y^2+\frac{q}{ab^2c}y+\frac{r}{c}=0$$

and multiplying the whole equation by $a^3b^3c^3$, we have

$$y^3+bcpy^2+a^2bc^2qy+a^3b^3c^2r=0.$$

Thus we have an equation free from fractions, while at the ſame time the coefficient of the higheſt power of the unknown quantity is unity, as before.

189. This transformation may always be performed by the following rule. Inſtead of the unknown quantity ſubſtitute a new unknown quantity divided by the product of all the denominators; then, by proper reduction, the equation will be found to have the form required.

190. If, however, the equation have this form,

$$x^3+\frac{p}{a}x^2+\frac{q}{a}x+\frac{r}{a}=0,$$

it will be ſufficient to aſſume $y=ax$, and therefore $x=\frac{y}{a}$; for then we have

$$\frac{y^3}{a^3}+\frac{p}{a^3}y^2+\frac{q}{a^2}y+\frac{r}{a}=0$$

And $y^3+py^2+aqy+a^2r=0$,
which laſt equation has the form required.

Sect. XI. *Of Cubic Equations.*

191. Cubic equations, as well as equations of every higher degree, are, like quadratics, divided into two claſſes; they are ſaid to be *pure*, when they contain only one power of the unknown quantity; and *adfected*, when they contain two or more powers of that quantity.

192. Pure cubic equations are therefore of this form $x^3=125$, or $x^3=-27$, or in general $x^3=r$; and hence it appears, that the value of the ſimple power of the unknown quantity may always be found, without difficulty, by extracting the cube root of each ſide of the equation; thus from the firſt of the three preceding examples we find $x=+5$, from the ſecond $x=-3$ and from the third $x=\sqrt[3]{r}$.

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193. It would ſeem at firſt ſight, that the only value which x can have in the cubic equation $x^3=r$, or putting $r=c^3$, $x^3-c^3=0$, is this one, $x=c$, but ſince x^3-c^3 may be reſolved into theſe two factors $x-c$ and x^2+cx+c^2, it follows, that beſides the value of x already found, which reſults from making the factor $x-c=0$, it has yet other two values, which may be found by making the other factor $x^2+cx+c^2=0$; and accordingly by reſolving the quadratic equation $x^2+cx=-c^2$, we find theſe values to be $\frac{-c+\sqrt{-3c^2}}{2}$ and $\frac{-c-\sqrt{-3c^2}}{2}$, or $\frac{-1+\sqrt{-3}}{2}c$ and $\frac{-1-\sqrt{-3}}{2}c$.

Thus it appears that any cubic equation of this form $x^3=c^3$, or $x^3-c^3=0$ has theſe three roots

$$x=c,\ x=\frac{-1+\sqrt{-3}}{2}c,\ x=\frac{-1-\sqrt{-3}}{2}c,$$

the firſt of which is real, but the two laſt are imaginary. If, however, each of the imaginary values of x be raiſed to the third power, the ſame reſults will be obtained as from the real value of x; the original equation $x^3-c^3=0$ may alſo be reproduced, by multiplying together the three factors $x-c$, $x-\frac{-1+\sqrt{-3}}{2}c$, and $x-\frac{-1-\sqrt{-3}}{2}c$.

194. Let us now conſider ſuch cubic equations as have all their terms, and which are therefore of this form

$$x^3+Ax^2+Bx+c=0$$

where A, B, and C denote known quantities, either poſitive or negative.

It has been ſhewn (§ 184) how an equation having all its terms may be transformed into another, which wants the ſecond term; let us therefore aſſume $x=y-\frac{A}{3}$, as directed in that article, then, by proper ſubſtitution, the above equation will be changed into another of this form

$$y^3+qy+r=0$$

where q and r denote known quantities, whether poſitive or negative, now the roots of this equation being once found, it is evident that thoſe of the former may alſo be readily obtained by means of the aſſumed equation $x=y-\frac{A}{3}$.

195. Reſuming, therefore, the equation $y^3+qy+r=0$, let us ſuppoſe $y=v+z$, and it becomes

$$\left.\begin{array}{r} v^3+3v^2z+3vz^2+z^3 \\ +qv+qz \\ +r \end{array}\right\}=0$$

Thus we have got a new equation, which, as it involves two unknown quantities v and z, may be reſolved into any two other equations, which will ſimplify the determination of thoſe quantities.

Now it appears, that the only way in which we can divide

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divide that equation into two others, so as to simplify the question, is the following

$$3v^2z+3vz^2+qv+qz=0$$
$$v^3+z^3+r=0$$

The first of these equations may also be expressed thus

$$(3vz+q)(v+z)=0$$

Hence we must either suppose that $v+z=0$, or that $3vz+q=0$; but the former supposition cannot be admitted, without supposing also that $y=0$, which does not agree with the hypothesis of the equation $y^3+qy+r=0$; therefore we must adopt the latter. So that to determine v and z we have these two equations

$$3vz+q=0,\ v^3+z^3+r=0.$$

From the first, we find $vz=-\frac{q}{3}$, and $v^3z^3=-\frac{q^3}{27}$; and from the second $v^3+z^3=-r$, so that to determine the quantities v^3 and z^3, we have given their sum, and product: now this is a problem which we have already resolved when treating of quadratic equations, § 155; and by proceeding in the same manner, in the present case, we shall find

$$v^3=-\tfrac{1}{2}r+\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}\quad z^3=-\tfrac{1}{2}r-\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}$$
$$v=\sqrt[3]{-\tfrac{1}{2}r+\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}}\quad z=\sqrt[3]{-\tfrac{1}{2}r-\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}}$$

and $y=v+z=\sqrt[3]{-\tfrac{1}{2}r+\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}}$
$+\sqrt[3]{-\tfrac{1}{2}r-\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{2}r^2}}$

Thus we have at last obtained a value of the unknown quantity y, in terms of the known quantities q and r; therefore the equation is resolved.

196. But this is only one of three values which y may have; let us, for the sake of brevity, put

$$A=-\tfrac{1}{2}r+\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2},\ B=-\tfrac{1}{2}r-\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2},$$

and denote the imaginary expressions

$$\frac{-1+\sqrt{-3}}{2},\ \frac{-1-\sqrt{-3}}{2}$$

by α and β. Then, from what has been shewn (§ 193), it is evident that v and z have each these three values

$$v=\sqrt[3]{A},\ v=\alpha\sqrt[3]{A},\ v=\beta\sqrt[3]{A}$$
$$z=\sqrt[3]{B},\ z=\alpha\sqrt[3]{B},\ z=\beta\sqrt[3]{B}$$

To determine the corresponding values of v and z, we must consider that $vz=-\frac{q}{3}=\sqrt[3]{AB}$; now if we observe that $\alpha\beta=1$, it will immediately appear that $v+z$ has these three values

$$v+z=\sqrt[3]{A}+\sqrt[3]{B}$$
$$v+z=\alpha\sqrt[3]{A}+\beta\sqrt[3]{B}$$
$$v+z=\beta\sqrt[3]{A}+\alpha\sqrt[3]{B}$$

Hence the three values of y are also these

$$y=\sqrt[3]{A}+\sqrt[3]{B}$$
$$y=\alpha\sqrt[3]{A}+\beta\sqrt[3]{B}$$
$$y=\beta\sqrt[3]{A}+\alpha\sqrt[3]{B}$$

The first of these formulæ is commonly known by the name of Cardan's rule; but it is well known that Cardan was not the inventor, and that it ought to be attributed to Nicholas Tartalea, and Scipio Ferreus, who discovered it much about the same time, and independently of each other (see the *Introduction*.)

197. The formulæ given in last article for the roots of a cubic equation may be put under a different form, and perhaps better adapted to the purposes of arithmetical calculation as follows. Because $vz=-\frac{q}{3}$, therefore $z=-\frac{q}{3}\times\frac{1}{v}=-\frac{q}{3}\times\frac{1}{\sqrt[3]{A}}$, hence $v+z=\sqrt[3]{A}-\frac{\frac{1}{3}q}{\sqrt[3]{A}}$; thus it appears that the three values of y may also be expressed thus

$$y=\sqrt[3]{A}-\frac{\frac{1}{3}q}{\sqrt[3]{A}}$$
$$y=\alpha\sqrt[3]{A}-\frac{\frac{1}{3}q\beta}{\sqrt[3]{A}}$$
$$y=\beta\sqrt[3]{A}-\frac{\frac{1}{3}q\alpha}{\sqrt[3]{A}}$$

198. To show the manner of applying these formulæ, let it be required to determine x from the cubic equation

$$x^3+3x^2+9x-13=0$$

And as this equation has all its terms, the first step towards its resolution is to transform it into another which shall want the second term, by substituting $y-1$ for x as directed (§ 184). The operation will stand thus

$$\begin{array}{rl} x^3= & y^3-3y^2+3y-1 \\ +3x^2= & \quad\ +3y^2-6y+3 \\ +9x= & \qquad\qquad +9y-9 \\ -13= & \qquad\qquad\quad -13 \\ \hline \end{array}$$

The transformed equation is $y^3\quad+6y-20=0$

which being compared with the general equation

$$y^3+qy+r=0$$

gives $q=6$, $r=-20$; hence

$$A=\sqrt[3]{-\tfrac{1}{2}r+\sqrt{\tfrac{1}{27}q^3+\tfrac{1}{4}r^2}}=\sqrt[3]{10+\sqrt{108}}$$

Therefore, the first formula of last article gives $y=\sqrt[3]{10+\sqrt{108}}-\frac{2}{\sqrt[3]{10+\sqrt{108}}}$; but as this expression involves a radical quantity, let the square root of 108 be taken and added to 10, and the cube root of the sum found; thus we have $\sqrt[3]{10+\sqrt{108}}=2.732$, nearly, and

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and therefore $\frac{2}{\sqrt[3]{10+\sqrt{108}}}=\frac{2}{2.732}=.732$; hence we at laſt find one of the values of y to be $2.732-.732=2$.

In finding the cube root of the radical quantity $\sqrt[3]{10+\sqrt{108}}$ we have taken only its approximate value, ſo as to have the expreſſion for the root under a rational form, and in this way we can always find, as near as we pleaſe, the cube root of any ſurd of the form $a+\sqrt{b}$ where b is a poſitive number. But it will ſometimes happen that the cube root of ſuch a ſurd can be expreſſed exactly by another ſurd of the ſame form; and accordingly, in the preſent caſe, it appears that the cube root of $10+\sqrt{108}$ is $1+\sqrt{3}$, as may be proved by actually raiſing $1+\sqrt{3}$ to the third power. Hence we find $\frac{2}{\sqrt[3]{10+\sqrt{108}}}=\frac{2}{1+\sqrt{3}}=\frac{2(1-\sqrt{3})}{(1-\sqrt{3})(1+\sqrt{3})}$ $=-(1-\sqrt{3})$; ſo that we have $y=1+\sqrt{3}+1-\sqrt{3}$ $=2$, as before.

The other two values of y will be had by ſubſtituting $1+\sqrt{3}$ and $1-\sqrt{3}$ for $\sqrt[3]{A}$ and $\frac{\frac{1}{3}q}{\sqrt[3]{A}}$ in the ſecond and third formulæ of laſt article, alſo reſtoring the values of α and β. We thus have

$$y=\frac{-1+\sqrt{-3}}{2}\times(1+\sqrt{3})+\frac{-1-\sqrt{-3}}{2}\times(1-\sqrt{3})$$
$$=-1+\sqrt{-9}$$
$$y=\frac{-1-\sqrt{-3}}{2}\times(1+\sqrt{3})+\frac{-1+\sqrt{-3}}{2}\times(1-\sqrt{3})$$
$$=-1-\sqrt{-9}$$

So that the three values of y are

$$+2,\ -1+\sqrt{-9},\ -1-\sqrt{9}$$

and ſince $x=y+1$, the correſponding values of x are

$$+1,\ -2+\sqrt{-9},\ -2-\sqrt{-9}$$

thus it appears that one of the roots of the propoſed equation is real and the other two imaginary.

The two imaginary roots might have been found otherwiſe, by conſidering that ſince one root of the equation is 1, the equation muſt be diviſible by $x-1$ (§ 163). Accordingly the diviſion being actually performed, and the quotient put $=0$, we have this quadratic equation

$$x^2+4x+13=0$$

which, when reſolved by the rule for quadratics, gives $x=-2\pm\sqrt{9}$, the ſame imaginary values as before.

199. In the application of the preceding formulæ (§ 196 and 197) to the reſolution of the equation $y^3+qy+r=0$, it is neceſſary to find the ſquare root of $\frac{1}{27}q^3+\frac{1}{4}r^2$, now when that quantity is poſitive, as in the equation $y^3+6y-20=0$, which was reſolved in laſt article, no difficulty occurs, for its root may be found, either exactly, or to as great a degree of accuracy as we pleaſe.

As, however, the coefficients q and r are independent of each other, it is evident that q may be negative, and ſuch that $\frac{1}{27}q^3$ is greater than $\frac{1}{4}r^2$, in this caſe the expreſſion $\frac{1}{27}q^3+\frac{1}{4}r^2$ will be negative, and therefore its ſquare root an imaginary quantity. Let us take as an example this equation $y^3-6y+4=0$; here $q=-6$, $r=+4$, $\frac{1}{2}r=2, \frac{1}{27}q^3=-8$, $\frac{1}{4}r^2=+4$, $\sqrt{\frac{1}{27}q^3+\frac{1}{4}r^2}=\sqrt{-4}=2\sqrt{-1}$, hence, by recurring to the formulæ (§ 196), we have $A=2+2\sqrt{-1}$, $B=2-\sqrt{-1}$, and therefore the three roots of the equation expreſſed thus

$$y=\sqrt[3]{2+2\sqrt{-1}}+\sqrt[3]{2-2\sqrt{-1}}$$
$$y=\alpha\sqrt[3]{2+2\sqrt{-1}}+\beta\sqrt[3]{2-2\sqrt{-1}}$$
$$y=\beta\sqrt[3]{2+2\sqrt{-1}}+\alpha\sqrt[3]{2-2\sqrt{-1}}$$

Here all the roots appear under an imaginary form; but we are certain from the theory of equations as explained in Sect. X. that every cubic equation muſt have at leaſt one real root. The truth is, as we ſhall ſhew immediately, that in this caſe, ſo far from any of the roots being imaginary (as in the former example), they are all real; for it appears by actual involution that the imaginary expreſſion $2+2\sqrt{-1}$ is the cube of this other imaginary expreſſion $-1+\sqrt{-1}$, and, in like manner, that $2-2\sqrt{-1}$ is the cube of $-1-\sqrt{-1}$, ſo that we have

$$y=\sqrt[3]{2+2\sqrt{-1}}+\sqrt[3]{2-2\sqrt{-1}}=-1+\sqrt{-1}-1-\sqrt{-1}=-2$$
$$y=\frac{-1+\sqrt{-3}}{2}\times(-1+\sqrt{-1})+\frac{-1-\sqrt{-3}}{2}\times(-1-\sqrt{-1})=1+\sqrt{3}$$
$$y=\frac{-1-\sqrt{-3}}{2}\times(-1+\sqrt{-1})+\frac{-1+\sqrt{-3}}{2}\times(-1-\sqrt{-1})=1-\sqrt{3}.$$

200. We now proceed to prove in general, that as often as the roots of the equation $x^3+qx+r=0$ are real, q is negative, and $\frac{1}{27}q^3$ greater than $\frac{1}{4}r^2$; and, on the contrary, that if $\frac{1}{27}q^3$ be greater than $\frac{1}{4}r^2$ the roots are all real.

Let us ſuppoſe a to be a real root of the propoſed equation,

Then $\quad x^3+qx+r=0$

And $\quad a^3+qa+r=0$

And therefore by ſubtraction $x^3-a^3+q(x-a)=0$; hence, dividing x^3-a^3, alſo $q(x-a)$ by $x-a$, we have

$$x^2+ax+a^2+q=0$$

This quadratic equation is formed from the two remaining roots of the propoſed equation, and by reſolving it we find

$$x=-\tfrac{1}{2}a\pm\sqrt{-\tfrac{3}{4}a^2-q}$$

And as, by hypotheſis, all the roots are real, it is evident that q muſt neceſſarily be negative, and greater than $\frac{3}{4}a^2$; for otherwiſe the expreſſion $\sqrt{-\frac{3}{4}a^2-q}$, would be imaginary. Let us change the ſign of q, and put

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put $q=\frac{3}{4}a^2+d$; thus the roots of the equation $x^3+qx+r=0$ will be

$$a,\ -\tfrac{1}{2}a+\sqrt{d},\ -\tfrac{1}{2}a-\sqrt{d},$$

and here d is a poſitive quantity.

To find an expreſſion for r in terms of a, and d, let $\frac{3}{4}a^2+d$ be ſubſtituted for q in the equation $a^3+qa+r=0$; we thence find $r=-\frac{1}{4}a^3+ad$; ſo that to compare together the quantities q and r we have theſe equations,

$$q=\tfrac{3}{4}a^2+d$$
$$r=-\tfrac{1}{4}a^3+ad.$$

In order to make this compariſon, let the cube of $\frac{1}{3}q$ be taken, alſo the ſquare of $\frac{1}{2}r$, the reſults are

$$\tfrac{1}{27}q^3=\tfrac{1}{64}a^6+\tfrac{1}{16}a^4d+\tfrac{1}{12}a^2d^2+\tfrac{1}{27}d^3.$$
$$\tfrac{1}{4}r^2=\tfrac{1}{64}a^6-\tfrac{1}{8}a^4d+\tfrac{1}{4}a^2d^2$$

and therefore, by ſubtraction,

$$\begin{aligned}\tfrac{1}{27}q^3-\tfrac{1}{4}r^2&=\tfrac{3}{16}a^4d-\tfrac{1}{6}a^2d^2+\tfrac{1}{27}d^3\\&=3d(\tfrac{1}{16}a^4-\tfrac{1}{18}a^2d+\tfrac{1}{81}d^2\\&=3d(\tfrac{1}{4}a^2-\tfrac{1}{9}d)^2,\end{aligned}$$

Now the ſquare of any real quantity being always poſitive, it follows that $3d(\frac{1}{4}a^2-\frac{1}{9}d)^2$ will be poſitive when d is poſitive; hence it is evident that in this caſe $\frac{1}{27}q^3$ muſt be greater than $\frac{1}{4}r^2$; and that the contrary cannot be true unleſs d be negative, that is, unleſs that $-\frac{1}{2}a+\sqrt{d}$, $-\frac{1}{2}a-\sqrt{d}$, the two other roots of the equation, are imaginary. If we ſuppoſe $d=0$, then $\frac{1}{27}q^3=\frac{1}{4}r^2$, and the roots of the equations, which in this caſe are alſo real, are a, $-\frac{1}{2}a$, $-\frac{1}{2}a$.

Upon the whole, therefore, we infer, that ſince a cubic equation has always one real root, its roots will be all real as often as q is negative, and $\frac{1}{27}q^3$ greater than $\frac{1}{4}r^2$; and conſequently, that in this caſe the formulæ for the roots muſt expreſs real quantities notwithſtanding their imaginary form.

201. Let $y^3-qy+r=0$ denote any equation of the form which has been conſidered in laſt article, namely, that which has its roots all real, then, if we put $a=-\frac{1}{2}r$, $b=\frac{1}{27}q^3-\frac{1}{4}r^2$, one of the roots, as expreſſed by the firſt formula, § 196, will be

$$y=\sqrt[3]{a+b\sqrt{-1}}+\sqrt[3]{a-b\sqrt{-1}}$$

This expreſſion, although under an imaginary form, muſt (as we have ſhewn in laſt article) repreſent a real quantity. It will ſometimes happen, as in laſt example, § 199, that the two ſurds which compoſe the root are perfect cubes of the form $(A+B\sqrt{-1})^3$ and $(A-B\sqrt{-1})^3$, and then the value of y becomes

$$A+B\sqrt{-1}+A-B\sqrt{-1}=2A.$$

But the rules for determining when this is the caſe depend upon trials, and are beſides troubleſome in the application: And if we attempt by a direct proceſs to inveſtigate the numerical values of A and B, we are brought to a cubic equation, of the very ſame form as that whoſe root is required.

202. This imaginary expreſſion for a real quantity has greatly perplexed mathematicians; and much pains has been taken to obtain the root under another form, but without ſucceſs. Accordingly the caſe of cubic equations, in which the roots are all real, is now called the *irreducible caſe.*

203. It is remarkable that the expreſſion

$$\sqrt{a+b\sqrt{-1}},+\sqrt{a-b\sqrt{-1}},$$

and in general,

$$\sqrt[n]{a+b\sqrt{-1}},+\sqrt[n]{a-b\sqrt{-1}},$$

where n is any power of 2, admits of being reduced to another form in which no impoſſible quantity is found

Thus $\sqrt{a+b\sqrt{-1}}+\sqrt{a-b\sqrt{-1}}=\sqrt{2a+2\sqrt{a^2+b^2}}$

$$\sqrt[4]{a+b\sqrt{-1}}+\sqrt[4]{a-b\sqrt{-1}}=$$
$$\sqrt{\left(\sqrt{2a+2\sqrt{a^2+b^2}}+2\sqrt[4]{a^2+b^2}\right)},$$

as is eaſily proved by firſt ſquaring the imaginary formulæ, and then taking the ſquare root of each. But when n is 3, it does not ſeem that ſuch reduction can poſſibly take place.

204. If each of the ſurds be expanded into an infinite ſeries and their ſum be taken, the imaginary quantity $\sqrt{-1}$ will vaniſh; and thus the root may be found by a direct proceſs. There are, however, other methods which ſeem preferable, and the following which is derived from the application of algebra to geometry ſeems to be the beſt.

205. It will be demonſtrated in Sect. XXV, that if a denote an arch of a circle, the relation between the coſine of the arch and the coſine of $\frac{a}{3}$, one-third of that arch is expreſſed by the following cubic equation.

$$\text{Cof.}^3\frac{a}{3}-\tfrac{3}{4}\,\text{cof.}\,\frac{a}{3}=\text{cof.}\,a.$$

Let us aſſume $\text{cof.}\,\frac{a}{3}=\frac{y}{n}$, then, by ſubſtitution, the equation is transformed into the following

$$\frac{y^3}{n^3}-\frac{3y}{4n}=\text{cof.}\,a.$$

$$\text{Or}\qquad y^3-\frac{3n^2}{4}y=n^3\times\text{cof.}\,a.$$

and in this cubic equation one of the roots is evidently $y=n\times\text{cof.}\,\frac{a}{3}$: Now from the arithmetic of ſines it appears that cof. a, cof. $(360°-a)$ and cof. $(360°+a)$ are all expreſſed by the ſame quantity; therefore the equation muſt have for a root, not only $n\times\text{cof.}\,\frac{a}{3}$, but alſo $n\times\text{cof.}\,\frac{360°-a}{3}$, and $n\times\text{cof.}\,\frac{360°+a}{3}$. But from the arithmetic of ſines $\text{cof.}\,\frac{360°-a}{3}=-\text{ſin.}\,\frac{90°-a}{3}$, and $\text{cof.}\,\frac{360°+a}{3}=-\text{ſin.}\,\frac{90+a}{3}$. Therefore the three roots of the equation are

$$n\times\text{cof.}\,\frac{a}{3},\ -n\times\text{ſin.}\,\frac{90°-a}{3},\ -n\times\text{ſin.}\,\frac{90°+a}{3}.$$

Let us next ſuppoſe that $y^3-qy=r$ is a cubic equation

tion whoſe roots are required, and let us compare it with the former equation $y^3 - \frac{3n^2}{4}y = n^3 \times \text{coſ. } a$; then it is evident that if we aſſume the quantities n and coſ. a, ſuch, that

$$\frac{3n^2}{4} = q, \quad n^3 \times \text{coſ. } a = r$$

the two equations will become identical, and thus their roots will be expreſſed by the very ſame quantities. But from theſe two aſſumed equations we find

$$n = \sqrt{\frac{4q}{3}} = \frac{2\sqrt{q}}{\sqrt{3}}, \quad \text{coſ. } a = \frac{r}{n^3} = \sqrt{\frac{27r^2}{4q^3}} = \frac{3r\sqrt{3}}{2q\sqrt{q}}$$

and ſince the coſine of an arch cannot exceed unity, therefore, $\frac{27r^2}{4q^3}$ muſt be a proper fraction, that is $4q^3$ muſt exceed $27r^2$, or $\frac{1}{27}q^3$ muſt exceed $\frac{1}{4}r^2$; if we now recollect that q is a negative quantity it will immediately appear that the propoſed equation muſt neceſſarily belong to the irreducible caſe.

206. The rule, therefore which we derive from the preceding analyſis for reſolving that caſe is as follows.

Let $y^3 - qy = r$ be the propoſed equation.

Find in the trigonometrical tables an arch a, whoſe natural coſine $= \frac{3r\sqrt{3}}{2q\sqrt{q}}$.

The roots of the equation are

$$y = 2\sqrt{\frac{q}{3}} \times \text{coſ. } \frac{a}{3}$$

$$y = -2\sqrt{\frac{q}{3}} \times \text{ſin. } \frac{90^\circ - a}{3}$$

$$y = -2\sqrt{\frac{q}{3}} \times \text{ſin. } \frac{90^\circ + a}{3}$$

Theſe formulæ will apply, whether r be poſitive or negative, by proper attention to the ſigns: If, however, r be negative, or the equation have this form, $y^3 - qy = -r$, the following will be more convenient:

Find in the tables an arch a, whoſe ſine $= \frac{3r\sqrt{3}}{2q\sqrt{q}}$

Then the roots of the equation are

$$y = 2\sqrt{\frac{q}{3}} \times \text{ſin. } \frac{a}{3}$$

$$y = 2\sqrt{\frac{q}{3}} \times \text{coſ. } \frac{90^\circ + a}{3}$$

$$y = -2\sqrt{\frac{q}{3}} \times \text{coſ. } \frac{90^\circ - a}{3}.$$

The laſt formulæ are derived from the equation

$$\text{Sin. }^3\frac{a}{3} - \frac{3}{4}\text{ ſin. } \frac{a}{3} = -\text{ ſin. } a$$

in the ſame manner as the former were found from the firſt equation of laſt article.

Ex. 1. It is required to find the roots of the equation $x^3 - 3x = 1$.

$$\text{Here } \frac{3r\sqrt{3}}{2q\sqrt{q}} = \frac{3\times\sqrt{3}}{6\times\sqrt{3}} = \tfrac{1}{2} = \text{coſ. } 60^\circ = \text{coſ. } a.$$

$$\text{Hence } \begin{cases} x = 2 \text{ coſ. } \frac{60^\circ}{3} = 2 \text{ coſ. } 20^\circ = 1.8793852 \\ x = -2 \text{ ſin. } \frac{150^\circ}{3} = -2 \text{ ſin. } 50^\circ = -1.5320888 \\ x = -2 \text{ ſin. } \frac{30^\circ}{3} = -2 \text{ ſin. } 10^\circ = .3472964. \end{cases}$$

Ex. 2. It is required to find the roots of the equation $x^3 - 3x - 1$.

$$\text{Here } \frac{3r\sqrt{3}}{2q\sqrt{q}} = \frac{3\sqrt{3}}{6\sqrt{3}} = \tfrac{1}{2} = \text{ſin. } 30^\circ = \text{ſin. } a.$$

$$x = 2 \text{ ſin. } \frac{30^\circ}{3} = 2 \text{ ſin. } 10^\circ = \quad .3472964$$

$$x = 2 \text{ coſ. } \frac{120^\circ}{3} = 2 \text{ coſ. } 40^\circ = \quad 1.5320888$$

$$x = -2 \text{ coſ. } \frac{60^\circ}{3} = -2 \text{ coſ. } 20^\circ = -1.8793852.$$

Sect. XII. *Of Biquadratic Equations.*

207. When a biquadratic equation contains all its terms, it has this form,

$$x^4 + Ax^3 \; Bx^2 + Cx + D = 0$$

where A, B, C, D, denote any known quantities whatever.

208. We ſhall firſt conſider pure biquadratics, or ſuch as contain only the firſt and laſt terms, and therefore are of this form $x^4 = b^4$. In this caſe it is evident that x may be readily had by two extractions of the ſquare root; by the firſt we find $x^2 = b^2$ and by the ſecond $x = b$. This, however, is only one of the values which x may have; for ſince $x^4 = b^4$, therefore $x^4 - b^4 = 0$; but $x^4 - b^4$ may be reſolved into two factors $x^2 - b^2$ and $x^2 + b^2$, each of which admit of a ſimilar reſolution; for $x^2 - b^2 = (x-b)(x+b)$ and $x^2 + b^2 = (x - b\sqrt{-1})(x + b\sqrt{-1})$. Hence it appears that the equation $x^4 - b^4 = 0$ may alſo be expreſſed thus:

$$(x-b)(x+b)(x-b\sqrt{-1})(x+b\sqrt{-1}) = 0,$$

ſo that x may have theſe four values,

$$+b, \; -b, \; +b\sqrt{-1}, \; -b\sqrt{-1},$$

two of which are real and the others imaginary.

209. Next to pure biquadratic equations, in reſpect of eaſineſs of reſolution, are ſuch as want the ſecond and fourth terms, and therefore have this form,

$$x^4 + qx^2 + s = 0.$$

Theſe may be reſolved in the manner of quadratic equations; for if we put $y^2 = x^2$ we have

$$y^2 + qy + s = 0$$

from which we find $y = \frac{-q \pm \sqrt{q^2 - 4s}}{2}$, and therefore $x = \pm\sqrt{\frac{-q \pm \sqrt{q^2 - 4s}}{2}}$.

210. When a biquadratic equation has all its terms, the manner of reſolving it is not ſo obvious as in the two former caſes, but its reſolution may be always reduced to that of a cubic equation. There are various methods by which ſuch a reduction may be effected; the following, which we ſelect as one of the moſt ingenious, was firſt given by Euler in the Peterſburgh Commentaries,

and

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and afterwards explained more fully in his Elements of Algebra.

We have already explained § 184, in what manner an equation which is complete in its terms may be tranſformed into another equation of the ſame degree, but which wants the ſecond term; therefore, any propoſed biquadratic equation may be reduced to this form,

$$y^4+py^2+qy+r=0$$

where the ſecond term is wanting, and where p, q, r, denote any known quantities whatever.

211. That we may form any equation ſimilar to the above, let us aſſume $y=\sqrt{a}+\sqrt{b}+\sqrt{c}$, and let us alſo ſuppoſe that the letters a, b, c, denote the roots of the cubic equation

$$z^3+Pz^2+Qz-R=0$$

then from the theory of equations we have

$$a+b+c=-P,\ ab+ac+bc=Q\ abc=R.$$

Let us now ſquare the aſſumed formula $y=\sqrt{a}+\sqrt{b}+\sqrt{c}$, and we obtain
$y^2=a+b+c+2(\sqrt{ab}+\sqrt{ac}+\sqrt{bc})$
or ſubſtituting $-P$ for $a+b+c$, and tranſpoſing,
$y^2+P=2(\sqrt{ab}+\sqrt{ac}+\sqrt{bc})$.
Let this equation be alſo ſquared and we have
$y^4+2Py^2+P^2=4(ab+ac+bc)+8(\sqrt{a^2bc}+\sqrt{ab^2c}+\sqrt{abc^2})$, and ſince $ab+ac+bc=Q$
and $\sqrt{a^2bc}+\sqrt{ab^2c}+\sqrt{abc^2}=\sqrt{abc}(\sqrt{a}+\sqrt{b}+\sqrt{c})=\sqrt{R}y$; the ſame equation may be expreſſed thus:

$$y^4+2Py^2+P^2=4Q+8\sqrt{R}y.$$

Thus we have obtained the biquadratic equation

$$y^4+2Py^2-8\sqrt{R}y+P^2-4Q=0,$$

one of the roots of which $y=\sqrt{a}+\sqrt{b}+\sqrt{c}$, and in which a, b, c are the roots of the cubic equation $z^3+Pz^2+Qz-R=0$.

212. That we may apply this reſolution to the propoſed equation $y^4+py^2+qy+r=0$, we muſt expreſs the aſſumed coefficients P, Q, R by means of p, q, r the coefficients of that equation. For this purpoſe let us compare together the equations;

$$y^4+py^2+qy+r=0$$
$$y^4+2Py^2-8\sqrt{R}y+P^2-4Q=0,$$

and it immediately appears that $2P=p$, $-8\sqrt{R}=q$, $P^2-4Q=r$; and from theſe three equations we find $P=\frac{p}{2}$, $Q=\frac{p^2-4r}{16}$, $R=\frac{q^2}{64}$. Hence it follows, that the roots of the propoſed equation are generally expreſſed by the formula $y=\sqrt{a}+\sqrt{b}+\sqrt{c}$; where a, b, c denote the roots of this cubic equation

$$z^3+\frac{p}{2}z^2+\frac{p^2-4r}{16}z-\frac{q^2}{64}=0.$$

213. But to find each particular root, we muſt conſider, that as the ſquare root of a number may be either poſitive or negative, ſo each of the quantities $\sqrt{a}$, $\sqrt{b}$, $\sqrt{c}$ may have either the ſign + or − prefixed to it; and hence our formula will give eight different expreſſions for the root. It is, however, to be obſerved, that as the product of the three quantities $\sqrt{a}$, $\sqrt{b}$, $\sqrt{c}$ muſt be equal to $\sqrt{R}$ or to $-\frac{q}{8}$, therefore when q is poſitive, their product muſt be a negative quantity; and this can only be effected by making either one or three of them negative; again, when q is negative, their product muſt be a poſitive quantity, ſo that in this caſe they muſt either be all poſitive, or two of them muſt be negative. Theſe conſiderations enable us to determine, that four of the eight expreſſions for the root belong to the caſe in which q is poſitive, and the other four to that in which it is negative.

Biquadratic Equations.

214. We ſhall now give the reſult of the preceding inveſtigation, in the form of a practical rule, for reſolving biquadratic equations; and as the coefficients of the cubic equation which has been found, § 212, involve fractions, we ſhall tranſform it into another, in which the coefficients are integers, by ſuppoſing $z=\frac{v}{4}$. Thus the equation $z^3+\frac{p}{2}z^2+\frac{p^2-4r}{16}z-\frac{q^2}{64}=0$ becomes, after reduction, $v^3+2pv^2+(p^2-4r)v-q^2=0$; it alſo follows, that ſince the roots of the former equation are a, b, c, the roots of the latter are $\frac{a}{4}$, $\frac{b}{4}$, $\frac{c}{4}$, ſo that our rule may now be expreſſed thus:

Let $y^4+py^2+qy+r=0$ be any biquadratic equation wanting its ſecond term. Form this cubic equation

$$v^3+2pv^2+(p^2-4r)v-q^2=0,$$

and find its roots, which let us denote by a, b, c.

Then the roots of the propoſed biquadratic equation are

when q is negative	when q is poſitive
$y=\frac{1}{2}(\sqrt{a}+\sqrt{b}+\sqrt{c})$	$y=\frac{1}{2}(-\sqrt{a}-\sqrt{b}-\sqrt{c})$
$y=\frac{1}{2}(\sqrt{a}-\sqrt{b}-\sqrt{c})$	$y=\frac{1}{2}(-\sqrt{a}+\sqrt{b}+\sqrt{c})$
$y=\frac{1}{2}(-\sqrt{a}+\sqrt{b}-\sqrt{c})$	$y=\frac{1}{2}(\sqrt{a}-\sqrt{b}+\sqrt{c})$
$y=\frac{1}{2}(-\sqrt{a}-\sqrt{b}+\sqrt{c})$	$y=\frac{1}{2}(\sqrt{a}+\sqrt{b}-\sqrt{c})$.

215. This reſolution of biquadratic equations ſuggeſts the following general remarks upon the nature of their roots.

1. It is evident from the form of the roots, that if the cubic equation

$$v^3+2pv^2+(p^2-4r)v-q^2=0$$

have all its roots real, and poſitive, thoſe of the biquadratic equation ſhall be all real.

2. Since the laſt term of the cubic equation is negative, when its three roots are real, they muſt either be all poſitive, or two of them muſt be negative and one poſitive; for the laſt term is equal to the product of all the roots taken with contrary ſigns, § 169; ſo that in this laſt caſe two of the three quantities a, b, c, muſt be negative, and therefore all the four roots of the biquadratic equation imaginary. If, however, the two negative roots be equal, they will deſtroy each other in two of the roots of the biquadratic equation, which will then become real and equal. Let us ſuppoſe for example that b and c are negative, and equal; the two firſt values of y in each column become then imaginary,

nary, and the remaining values of y are in the first set of roots $y=-\frac{1}{2}\sqrt{a}$, $y=-\frac{1}{2}\sqrt{a}$, and in the second $y=+\frac{1}{2}\sqrt{a}$, $y=\frac{1}{2}\sqrt{a}$.

3. When the cubic equation has only one real, and two imaginary roots, its real root must necessarily be positive. For the imaginary roots can only come from a quadratic equation, having its last term positive, Sect. IX. and therefore of this form $v^2+Av+B=0$, hence, the simple factor which contains the remaining root must have this form $v-\gamma$, otherwise the last term of the cubic equation could not be negative.

By resolving the equation $v^2+Av+B=0$, we find

$$v=-\frac{A}{2}\pm\sqrt{\frac{A^2}{4}-B};$$

here, the roots being supposed imaginary, $\frac{A^2}{4}-B$ must be a negative quantity. That we may simplify the form of the roots, let us put $-\frac{A}{2}=\alpha$ and $\frac{A^2}{4}-B=-\beta^2$, then

$$v=-\alpha\pm\sqrt{-\beta^2}=-\alpha\pm\beta\sqrt{-1}$$

and $v=-\alpha+\beta\sqrt{-1}$, $v=-\alpha-\beta\sqrt{-1}$

Hence we have

$$a=\alpha+\beta\sqrt{-1},\ b=\alpha-\beta\sqrt{-1},\ c=\gamma;$$

so that in two of the four values of y, we have a quantity of this form

$$\sqrt{\alpha+\beta\sqrt{-1}}+\sqrt{\alpha-\beta\sqrt{-1}}$$

but this quantity, although it appears to be imaginary, is indeed real; for if we first square it, and then take its square root, it becomes

$$\sqrt{2\alpha+2\sqrt{\alpha^2+\beta^2}}$$

which is a real quantity. The two other roots involve this other expression

$$\sqrt{\alpha+\beta\sqrt{-1}}-\sqrt{\alpha-\beta\sqrt{-1}}$$

which, being treated in the same manner as the former, becomes

$$\sqrt{2\alpha-2\sqrt{\alpha^2+\beta^2}}$$

an imaginary quantity, and therefore the roots, into which it enters, are imaginary.

4. We may discover from the coefficients of the proposed biquadratic equation in what case the roots of the cubic equation are all real; for this purpose the latter is to be transformed into another which shall want the second term by assuming $v=u-\frac{2p}{3}$; thus it becomes

$$u^3-\left(\frac{p^2}{3}+4r\right)u-\frac{2p^3}{27}+\frac{8rp}{3}-q^2=0;$$

and in this equation the three roots will be real when $\frac{1}{27}\left(\frac{p^2}{3}+4r\right)^3$ is greater than $\frac{1}{4}\left(\frac{2p^3}{27}-\frac{8rp}{3}+q^2\right)^2$.

216. As an example of the method of resolving a biquadratic equation, let it be required to determine the roots of the following,

$$x^4-25x^2+60x-36=0.$$

By comparing this equation with the general formula, we have $p=-25$, $q=+60$, $r=-36$, hence

$$2p=-50,\ p^2-4r=769,\ q^2=3600,$$

and the cubic equation to be resolved is

$$v^3-50v^2+769v-3600=0;$$

the roots of which are found by the rules for cubics, to be 9, 16, and 25, so that we have $\sqrt{a}=3$, $\sqrt{b}=4$, $\sqrt{c}=5$. Now in this case q is positive, therefore

$$x=\tfrac{1}{2}(-3-4-5)=-6$$
$$x=\tfrac{1}{2}(-3+4+5)=+3$$
$$x=\tfrac{1}{2}(+3-4+5)=+2$$
$$x=\tfrac{1}{2}(+3+4-5)=+1.$$

217. We have now explained the particular rules by which the roots of equations belonging to each of the first four orders may be determined; and this is the greatest length mathematicians have been able to go in the direct resolution of equations; for as to those of the fifth, and all higher degrees, no general method has hitherto been found, either for resolving them directly, or for reducing them to others of an inferior degree.

It even appears that the formulæ which express the roots of cubic equations are by no means of universal application; for in one case, that is, when the roots are all real, they become illusory, so that no conclusion can be drawn from them. The same observation will also apply to the formulæ for the roots of biquadratic equations, because, before they can be applied, it is always necessary to find the roots of a cubic equation. But in either cubics or biquadratic equations, even when the formulæ involve no imaginary quantities, and therefore can be always applied, it is more convenient in practice to employ some other methods which we are hereafter to explain.

Sect. XIII. *Of Reciprocal Equations.*

218. Although no general resolution has hitherto been given of equations belonging to the fifth, or any higher degree; yet there are particular equations of all orders, which by reason of certain peculiarities in the nature of their roots, admit of being reduced to others of a lower degree, and thus, in some cases, equations of the higher orders may be resolved by the rules which have been already explained for the resolution of equations belonging to the first four orders.

219. When the coefficients of the terms of an equation form the same numerical series, whether taken in a direct or an inverted order, as in this example

$$x^4+px^3+qx^2+px+1=0$$

that equation may always be transformed into another, of a degree denoted by half the exponent of the highest power of the unknown quantity, if that exponent be an even number, or by half the exponent diminished by unity, if it be an odd number.

The same observation will also apply to any equation of this form

$$x^4+pax^3+qa^2x^2+pa^3x+a^4=0$$

where the given quantity a and the unknown quantity

Reciprocal Equations.

x are precisely alike concerned; for by substituting ay for x, it becomes

$$a^4y^4+pa^4y^3+qa^4y^2+pa^4y+a^4=0;$$

and dividing by a^4,

$$y^4+py^3+qy^2+py+1=0,$$

an equation of the same kind as the former.

220. That we may effect the proposed transformation upon the equation

$$x^4+px^3+qx^2+px+1=0$$

let every two terms which are equally distant from the extremes be collected into one, and the whole be divided by x^2, thus we have

$$x^2+\frac{1}{x^2}+p\left(x+\frac{1}{x}\right)+q=0.$$

Let us assume $x+\frac{1}{x}=z$

Then $x^2+2+\frac{1}{x^2}=z^2$ and $x^2+\frac{1}{x^2}=z^2-2$

Thus the equation $x^2+\frac{1}{x^2}+p\left(x+\frac{1}{x}\right)+q=0$ becomes $z^2+pz+q-2=0$.

And since $x+\frac{1}{x}=z$, therefore $x^2-zx+1=0$.

221. Hence upon the whole, to determine the roots of the biquadratic equation

$$x^4+px^3+qx^2+px+1=0$$

we have the following rule.

Form this quadratic equation

$$z^2+pz+q-2=0$$

and find its roots, which let us suppose denoted by z' and z''. Then the four roots of the proposed equation will be found by resolving two quadratic equations

$$x^2-z'x+1=0,\ x^2-z''x+1=0.$$

222. It may be observed respecting these two quadratic equations, that since the last term of each is unity, if we put a, a' to denote the roots of the one, and b, b' those of the other, we have from the theory of equations $aa'=1$, and therefore $a'=\frac{1}{a}$, also $bb'=1$, and $b'=\frac{1}{b}$; now a, a', b, b' are also the roots of the equation

$$x^4+px^3+qx^2+px+1=0$$

Hence it appears that the proposed equation has this peculiar property, that the one half of its roots are the reciprocals of the other half; and to that circumstance we are indebted for the simplicity of its resolution.

223. The following equation

$$x^6+px^5+qx^4+rx^3+qx^2+px+1=0,$$

which is of the sixth order, admits of a resolution in all respects similar to the former; for by putting it under this form

$$x^3+\frac{1}{x^3}+p\left(x^2+\frac{1}{x^2}\right)+q\left(x+\frac{1}{x}\right)+r=0,$$

and putting also $x+\frac{1}{x}=z$, so that $x^2-zx+1=0$, we have $x^2+\frac{1}{x^2}=z^2-2$

$$x^3+\frac{1}{x^3}=z^3-3\left(x+\frac{1}{x}\right)=z^3-3z$$

Hence, by substitution, the proposed equation is transformed into the following cubic equation

$$z^3+pz^2+(q-3)z+r-2p=0.$$

Therefore, putting z', z'', z''' to denote its roots, the six roots of the proposed equation will be had by resolving these three quadratics

$$x^2-z'x+1=0,\ x^2-z''x+1=0,\ x^2-z'''x+1=0,$$

and here it is evident, as in the former case, that the roots of each quadratic equation are the reciprocals of each other, so that the one half of the roots of the proposed equation are the reciprocals of the other half.

224. The method of resolution we have employed in the two preceding examples is general for all equations whatever, in which the terms placed at equal distances from the first and last have the same coefficients, and which are called *reciprocal equations*, because any such equation has the same form when you substitute for x its reciprocal $\frac{1}{x}$.

225. If the greatest exponent of the unknown quantity in a reciprocal equation is an odd number, as in this example

$$x^5+px^4+qx^3+qx^2+px+1=0$$

the equation will always be satisfied by substituting -1 for x; hence -1 must be a root of the equation, and therefore the equation must be divisible by $x+1$. Accordingly, if the division be actually performed, we shall have in the present case

$$x^4+(p-1)x^3-(p-q-1)x^2+(p-1)x+1=0$$

another reciprocal equation, in which the greatest exponent of x is an even number, and therefore resolvable in the manner we have already explained.

Equations with equal Roots.

Sect. XIV. *Of Equations which have Equal Roots.*

226. When an equation has two or more of its roots equal to one another, those roots may always be discovered, and the equation reduced to another of an inferior degree, by a method of resolution which is peculiar to this class of equations; and which we now proceed to explain.

227. Although the method of resolution we are to employ will apply alike to equations having equal roots, of every degree, yet, for the sake of brevity, we shall take a biquadratic equation

$$x^4+px^3+qx^2+rx+s=0$$

the roots of which may be generally denoted by a, b, c, and d. Thus we have, from the theory of equations,

$$(x-a)(x-b)(x-c)(x-d)=x^4+px^3+qx^2+rx+s$$

Let us put

$$A=(x-a)(x-b)(x-c)\quad A''=(x-a)(x-c)(x-d)$$
$$A'=(x-a)(x-b)(x-d)\quad A'''=(x-b)(x-c)(x-d)$$

Then,

Equations with equal Roots.

Then, by actual multiplication, we have

$$A = x^3 \left.\begin{matrix}-a\\-b\\-c\end{matrix}\right\} x^2 \left.\begin{matrix}+ab\\+ac\\+bc\end{matrix}\right\} x - abc$$

$$A' = x^3 \left.\begin{matrix}-a\\-b\\-d\end{matrix}\right\} x^2 \left.\begin{matrix}+ab\\+ad\\+bd\end{matrix}\right\} x - abd$$

$$A'' = x^3 \left.\begin{matrix}-a\\-c\\-d\end{matrix}\right\} x^2 \left.\begin{matrix}+ac\\+ad\\+bd\end{matrix}\right\} x - acd$$

$$A''' = x^3 \left.\begin{matrix}-b\\-c\\-d\end{matrix}\right\} x^2 \left.\begin{matrix}+bc\\+bd\\+cd\end{matrix}\right\} x - bcd$$

and taking the sum of these four equations

$$A + A' + A'' + A''' = 4x^3 \left.\begin{matrix}-3a\\-3b\\-3c\\-3d\end{matrix}\right\} x^2 \left.\begin{matrix}+2ab\\+2ac\\+2ad\\+2bc\\+2bd\\+2cd\end{matrix}\right\} x \left.\begin{matrix}-abc\\-abd\\-acd\\-bcd\end{matrix}\right.$$

But since a, b, c, d are the roots of the equation

$$x^4 + px^3 + qx^2 + rx + s = 0$$

we have $-3(a+b+c+d) = 3p$
$2(ab+ac+ad+bc+bd+cd) = 2q$
$-(abc+abd+acd+bcd) = r$

Therefore, by substitution

$$A + A' + A'' + A''' = 4x^3 + 3px^2 + 2qx + r$$

228. Let us now suppose that the proposed biquadratic equation has two equal roots, or $a=b$, then $x-a = x-b$, and since one or other of these equal factors enters each of the four products A, A′, A″, A‴ it is evident that $A+A'+A''+A'''$ or $4x^3+3px^2+2qx+r$ must be divisible by $x-a$, or $x-b$. Thus it appears that if the proposed equation

$$x^4 + px^3 + qx^2 + rx + s = 0$$

has two equal roots, each of them must also be a root of this equation

$$4x^3 + 3px^2 + 2qx + r = 0 ;$$

for when the first of these equations is divisible by $(x-a)^2$ the latter is necessarily divisible by $x-a$.

229. Let us next suppose that the proposed equation has three equal roots or $a=b=c$, then two at least of the three equal factors $x-a$, $x-b$, $x-c$, must enter each of the four products A°, A', A'', A'''; so that in this case $A+A'+A''+A'''$, or $4x^3+3x^2+2qx+r$ must be twice divisible by $x-a$. Hence it follows that as often as the proposed equation has three equal roots, two of them must also be equal roots of the equation

$$4x^3 + 3px^2 + 2qx + r = 0$$

230. Proceeding in the same manner, it may be shewn that whatever number of equal roots are in the proposed equation

$$x^4 + px^3 + qx^2 + rx + s = 0$$

they will all remain except one, in this equation

$$4x^3 + 3px^2 + 2qx + r = 0,$$

which is evidently derived from the former, by multiplying each of its terms by the exponent of x in that term, and then diminishing the exponent by unity.

Equations with equal Roots.

231. If we suppose that the proposed equation has two equal roots or $a=b$, and also two other equal roots, or $c=d$, then, by reasoning as before, it will appear that the equation derived from it must have one root equal to a or b, and another equal to c or d, so that when the former is divisible both by $(x-a)^2$ and $(x-c)^2$, the latter will be divisible by $(x-a)\,(x-c)$.

232. The same mode of reasoning may be extended to all equations whatever; so that if we suppose
$x^m + Px^{m-1} + Qx^{m-2} \dots + Sx^2 + Tx + U = 0$
an equation of the mth degree to have a divisor of this form

$$(x-a)^n (x-d)^p (x-f)^q \dots \text{\&c.}$$

The equation

$$mx^{m-1} + (m-1)Px^{m-2} + (m-2)Qx^{m-3} \dots + 2Sx + T = 0,$$

which is of the next lower degree, will have for a divisor

$$(x-a)^{n-1}(x-d)^{p-1}(x-f)^{q-1} \dots \text{\&c.}$$

and as this last product must be a divisor of both equations, it may always be discovered by the rule which has been given (§ 49) for finding the greatest common divisor of two algebraic quantities.

233. Again, as this last equation must, in the case of equal roots, have the same properties as the original equation; therefore, if we multiply each of its terms by the exponent of x, and diminish that exponent by unity, as before, we have

$$m(m-1)x^{m-2} + (m-1)(m-2)Px^{m-3} + (m-2)(m-3)Qx^{m-4} \dots + 2S = 0,$$

a new equation, which will have for a divisor

$$(x-a)^{n-2}(x-d)^{p-2}(x-f)^{q-2},$$

where the exponent of the factors are one less than those of the equation from which it was derived; and as this last divisor is also a divisor of the original equation, it may be discovered in the same manner as the former, namely, by finding the greatest common measure of both equations; and so on we may proceed as far as we please.

234. As a particular example, let us take this equation

$$x^5 - 13x^4 + 67x^3 - 171x^2 + 216x - 108 = 0,$$

and apply to it the method we have explained, in order to discover whether it has equal roots, and if so, what they are. We must therefore seek the greatest common measure of the proposed equation and this other equation, which is formed agreeably to what has been shewn § 228,

$$5x^4 - 52x^3 + 201x^2 - 342x + 216 = 0$$

and the operation being performed, we find that they have a common divisor $x^3 - 8x^2 + 21x - 18$, which is of the third degree and consequently may have several factors. Let us therefore try whether the last equation and the following

$$20x^3 - 156x^2 + 402x - 342 = 0.$$

which is derived from it, as directed in § 228, have any common divisor; and by proceeding as before, we

 find

Equations with rational Roots.

find that they admit of this diviſor $x-3$, which is alſo a factor of the laſt diviſor $x^3-8x^2+21x-18$, and therefore the product of remaining factors is immediately found by diviſion to be x^2-5x+6 which is evidently reſolvable into $x-2$ and $x-3$.

Thus it appears upon the whole, that the common diviſor of the original equation, and that which is immediately derived from it, is $(x-2)(x-3)^2$; and that the common diviſor of the ſecond and third equations is $x-3$. Hence it follows that the propoſed equation has $(x-2)^2$ for one factor, and $(x-3)^3$ for another factor; ſo that the equation itſelf may be expreſſed thus, $(x-2)^2(x-3)^3=0$, and the truth of this concluſion may be eaſily verified by multiplication.

Sect. XV. *Reſolution of Equations whoſe Roots are rational.*

235. It has been ſhewn in § 169 that the laſt term of any equation is always the product of its roots taken with contrary ſigns: Hence it follows that when the roots are rational they may be diſcovered by the following rule.

Bring all the terms of the equation to one ſide; find all the diviſors of the laſt term, and ſubſtitute them ſucceſſively for the unknown quantity in the equation. Then each diviſor, which produces a reſult equal to 0, is a root of the propoſed equation.

Ex. 1. Let $x^3-4x^2-7x+10=0$ be the propoſed equation.

Then, the diviſors of 10 the laſt term are 1, 2, 5, 10, each of which may be taken either poſitively, or negatively, and theſe being ſubſtituted ſucceſſively for x, we obtain the following reſults.

By putting $+1$ for x,	$1-4-7+10=$	0
-1	$-1-4+7+10=$	12
$+2$	$8-16-14+10=$	-12
-2	$-8-16+14+10=$	0
$+5$	$125-100-35+10=$	0

Here the diviſors which produce reſults equal to 0 are $+1$, -2 and $+5$, and therefore theſe numbers are the three roots of the propoſed equation.

236. When the number of diviſors to be tried happens to be conſiderable, it will be convenient to tranſform the propoſed equation into another, in which the laſt term has fewer diviſors. This may, in general, be done by forming an equation, the roots of which are greater or leſs than thoſe of the propoſed equation by ſome determinate quantity, as in the following example:

Ex. 2. Let $y^4-4y^3-8y+32=0$ be propoſed.

Here the diviſors to be tried are 1, 2, 4, 8, 16, 32, each taken either poſitively or negatively; but to prevent the trouble of ſo many ſubſtitutions, let us tranſform the equation, by putting $x+1$ for y.

$$\begin{array}{lrl}
\text{Then} & y^4= & x^4+4x^3+6x^2+4x+1 \\
 & -4y^3= & \quad\; -4x^3-12x^2-12x-4 \\
 & -8y= & \qquad\qquad\qquad\;\; -8x-8 \\
 & +32= & \qquad\qquad\qquad\qquad\;\; +32 \\
\hline
\text{Therefore} & & x^4 \qquad -6x^2-16x+21=0
\end{array}$$

Equations with rational Roots.

is the transformed equation, and the diviſors of the laſt term are $+1, -1, +3, -3, +7, -7$. Theſe being put ſucceſſively for x, we get $+1$ and $+3$ for two roots of the equation; and as to the two remaining roots, it is eaſy to ſee that they muſt be imaginary. They may, however, be readily exhibited by conſidering, that the equation $x^4-6x^2-16x+21=0$ is diviſible by the product of the two factors $x-1$ and $x-3$, and therefore may be reduced to a quadratic. Accordingly, by performing the diviſion, and putting the quotient equal 0, we have this equation,

$$x^2+4x+7+=0,$$

the roots of which are the imaginary quantities $-2+\sqrt{-3}$ and $-2-\sqrt{-3}$; ſo that ſince $y=x+1$, the roots of the equation $y^4-4y^3-8y+32=0$ are theſe, $y=+2$, $y=+4$, $y=-1+\sqrt{-3}$, $y=-1-\sqrt{-3}$.

If this literal equation were propoſed

$$x^3-(3a+b)x^2+(2a^2+3ab)x-2a^2b=0,$$

by proceeding as before, we ſhould find $x=a$, $x=2a$, $x=b$ for the roots.

237. To avoid the trouble of trying all the diviſors of the laſt term, a rule may be inveſtigated for reſtricting the number to very narrow limits as follows:

Suppoſe that the cubic equation $x^3+px^2+qx+r=0$ is to be reſolved. Let it be transformed into another, the roots of which are leſs than thoſe of the propoſed equation by unity: this may be done by aſſuming $y=x-1$, and the laſt term of the transformed equation will be $1+p+q+r$. Again, by aſſuming $y=x+1$ another equation will be formed whoſe roots exceed thoſe of the propoſed equation by unity, and the laſt term of this other transformed equation will be $-1+p-q+r$. And here it is to be obſerved, that theſe two quantities $1+p+q+r$ and $-1+p-q+r$ are formed from the propoſed equation x^3+px^2+qx+r by ſubſtituting in it ſucceſſively $+1$ and -1 for x.

Now the values of x are ſome of the diviſors of r, which is the term left in the propoſed equation, when x is ſuppoſed $=0$; and the values of the y's are ſome of the diviſors of $1+p+q+r$ and $-1+p-q+r$ reſpectively; and theſe values are in arithmetical progreſſion, increaſing by the common difference unity; becauſe $x-1, x, x+1$ are in that progreſſion; and it is obvious, that the ſame reaſoning will apply to an equation of any degree whatever. Hence the following rule.

Subſtitute in place of the unknown quantity, ſucceſſively, three or more terms of the progreſſion $1, 0, -1$, &c. and find all the diviſors of the ſums that reſult, then take out all the arithmetical progreſſions that can be found among theſe diviſors, whoſe common difference is 1, and the values of x will be among theſe terms of the progreſſions, which are the diviſors of the reſult ariſing from the ſubſtitution of $x=0$. When the ſeries increaſes, the roots will be poſitive; and, when it decreaſes, they will be negative.

Ex. 1. Let it be required to find a root of the equation $x^3-x^2-10x+6=0$.

The

The operation.

Subſtit.		*Reſult.*	*Diviſors.*	*Ar. Pro.*
$x=+1$	$x^3-x^2-10x+6=$	-4	1. 2. 4.	4
$x=\ \ 0$		$+6$	1. 2. 3. 6.	3
$x=-1$		$+14$	1. 2. 7. 14.	2

In this example there is only one progreſſion, 4, 3, 2, the term of which oppoſite to the ſuppoſition of $x=0$ being 3, and the ſeries decreaſing, we try if -3 ſubſtituted for x makes the equation vaniſh, and as it ſucceeds, it follows that -3 is one of its roots. To find the remaining roots, if $x^3-x^2-10x+6$ be divided by $x+3$, and the quotient x^2-4x+2 put $=0$, they will appear to be $2+\sqrt{2}$ and $2-\sqrt{2}$.

Ex. 2. Let the propoſed equation be

$$x^4+x^3-29x^2-9x+180=0.$$

To find its roots.

Sub.	*Reſ.*	*Diviſors.*	*Progreſſions*			
2	70	1. 2. 5. 7. 10. 14. 35. 70.	1	2	5	7
1	144	1. 2. 3. 4. 6. 8. 9. 12, &c.	2	3	4	6
0	180	1. 2. 3. 4. 5. 6. 9. 10, &c.	3	4	3	5
—1	160	1. 2. 4. 5. 8. 10. 16. 20, &c.	4	5	2	4
—2	90	1. 2. 3. 5. 6. 9. 10. 15, &c.	5	6	1	3

Here there are four progreſſions, two increaſing and two decreaſing: hence, by taking their terms, which are oppoſite to the ſuppoſition of $x=0$, we have theſe four numbers to be tried as roots of the equation $+3$, $+4$, -3, -5, all of which are found to ſucceed.

238. If any of the coefficients of the propoſed equation be a fraction, the equation may be transformed into another, having the coefficient of the higheſt power unity, and thoſe of the remaining terms integers by § 189 and the roots of the transformed equation being found, thoſe of the propoſed equation may be eaſily derived from them.

For example, if the propoſed equation be $x^3-\frac{7}{4}x^2+\frac{35}{4}x-6=0$. Let us aſſume $x=\frac{y}{4}$, thus the equation is transformed to

$$\frac{y^3}{64}-\frac{7y^2}{64}+\frac{35y}{16}-6=0,$$

$$\text{Or } y^3-7y^2+140y-384=0,$$

one root of which is $y=3$; hence $x=\frac{y}{4}=\frac{3}{4}$.

The propoſed equation being now divided by $x-\frac{3}{4}$ is reduced to this quadratic $x^2-x+8=0$ the roots of which are both impoſſible.

239. When the coefficients of an equation are integers, and that of the higheſt power of the unknown quantity unity, if its roots are not found among the diviſors of the laſt term, we may be certain that, whether the equation be pure or adfected, its roots cannot be exactly expreſſed either by whole numbers or rational fractions. This may be demonſtrated by means of the following propoſition. If a prime number P be a diviſor of the product of two numbers A, and B; it will alſo be a diviſor of at leaſt one of the numbers.

240. Let us ſuppoſe that it does not divide B, and that B is greater than P; then, putting q for the greateſt number of times that P can be had in B, and B' for the remainder, we have $\frac{B}{P}=q+\frac{B'}{P}$, and therefore

$$\frac{AB}{P}=qA+\frac{AB'}{P}$$

Hence it appears, that if P be a diviſor of AB, it is alſo a diviſor of AB'. Now B' is leſs than P, for it is the remainder which is found in dividing B by P; therefore, ſeeing we cannot divide B' by P, let P be divided by B', and q' put for the quotient, alſo B'' for the remainder; again let P be divided by B'', and q'' put for the quotient, and B''' for the remainder, and ſo on; and as P is ſuppoſed to be a prime number, it is evident that this ſeries of operations may be continued till a remainder be found equal to unity, which will at laſt be the caſe, for the diviſors are the ſucceſſive remainders of the diviſions, and therefore each is leſs than the diviſor which preceded it. By performing theſe operations we obtain the following ſeries of equations

$$\left.\begin{array}{l} P=q'B'+B'' \\ P=q''B''+B''', \\ \quad\text{\&c.} \end{array}\right\} \text{and therefore} \left\{\begin{array}{l} B'=\dfrac{P-B''}{q'} \\ B''=\dfrac{P-B'''}{q''}, \\ \quad\text{\&c.} \end{array}\right.$$

Hence we have $AB'=\dfrac{AP-AB''}{q'}$, and

$$\frac{q'AB'}{P}=\frac{AP-AB''}{P}=A-\frac{AB''}{P}$$

Now, if AB be diviſible by P, we have ſhewn that AB', and conſequently $q'AB'$ is diviſible by P, therefore, from the laſt equation, it appears that AB'' muſt alſo be diviſible by P.

Again, from the preceding ſeries of equations, we have $AB''=\dfrac{AP-AB'''}{q''}$, and therefore

$$\frac{q''AB''}{P}=\frac{AP-AB'''}{P}=A-\frac{AB'''}{P};$$

hence we conclude that AB''' is alſo diviſible by P.

Proceeding in this manner, and obſerving that the ſeries of quantities B', B'', B''', &c. continually decreaſe till one of them $=1$, it is evident that we ſhall at laſt come to a product of this form $A\times 1$, which muſt

must be divisible by P, and hence the truth of the proposition is manifest.

241. It follows from this proposition, that if the prime number P, which we have supposed not to be a divisor of B, is at the same time not a divisor of A, it cannot be a divisor of AB the product of A and B.

242. Let $\frac{b}{a}$ be a fraction in its lowest terms, then the numbers a and b have no common divisor; but from what has been just now shewn, it appears, that if a prime number be not a divisor of a it cannot be a divisor of $a \times a$ or a^2, and in like manner, that if a prime number is not a divisor of b, it cannot be a divisor of $b \times b$, or b^2; therefore, it is evident that a^2 and b^2 have no common divisor, and thus the fraction $\frac{b^2}{a^2}$ is also in its lowest terms.

Hence it follows that the square of any fractional quantity is still a fraction, and cannot possibly be a whole number; and, on the contrary, that the square root of a whole number cannot possibly be a fraction; so that all such whole numbers as are not perfect squares can neither have their roots expressed by integers nor by fractions.

243. Since that if a prime number is not a divisor of a, it is also not a divisor of a^2, therefore if it is not a divisor of a, it cannot be a divisor of $a \times a^2$ or a^3, § 241, and by reasoning in this way, it is obvious that if a prime number is not a divisor of a, it cannot be a divisor of a^n; also, that if it is not a divisor of b, it cannot be a divisor of b^n, therefore if $\frac{b}{a}$ is a fraction in its lowest terms $\frac{b^n}{a^n}$ is also a fraction in its lowest terms; so that any power whatever of a fraction is also a fraction, and on the contrary, any root of a whole number is also a whole number. Hence it follows that if the root of a whole number is not expressible by an integer, such root cannot be expressed by a fraction, but is therefore irrational or incommensurable.

244. Let us next suppose that

$$x^n + Px^{n-1} + Qx^{n-2} \ldots + Tx + U = 0$$

is any equation whatever, in which P, Q, &c. denote integer numbers; then if its roots are not integers they cannot possibly be rational fractions. For if possible, let us suppose $x = \frac{b}{a}$, a fraction reduced to its lowest terms, then, by substitution

$$\frac{a^n}{b^n} + P\frac{a^{n-1}}{b^{n-1}} + Q\frac{a^{n-2}}{b^{n-2}} \ldots + T\frac{a}{b} + U = 0$$

and, reducing all the terms to a common denominator,

$$a^n + Pa^{n-1}b + Qa^{n-2}b^2 \ldots + Tab^{n-1} + Ub^n = 0,$$

which equation may also be expressed thus

$$a^n + b(Pa^{n-1} + Qa^{n-2}b \ldots + Tab^{n-2} + Ub^{n-1}) = 0,$$

where the equation consists of two parts, one of which is divisible by b. But by hypothesis a and b have no common measure, therefore a^n is not divisible by b, § 243, hence it is evident that the two parts of the equation cannot destroy each other as they ought to do; therefore x cannot possibly be a fraction.

I

SECT. XVI. *Resolution of Equations by Approximation.*

245. WHEN the roots of an equation cannot be accurately expressed by rational numbers, it is necessary to have recourse to the methods of approximation, and by these we can always determine the numerical values of the roots to as great a degree of accuracy as we please.

246. The application of the methods of approximation is rendered easy by means of the following principles:

If two numbers, either whole or fractional, be found, which, when substituted for the unknown quantity in any equation, produce results with contrary signs; we may conclude that at least one root of the proposed equation is between those numbers, and is consequently real.

Let the proposed equation be

$$x^3 - 5x^2 + 10x - 15 = 0$$

which, by collecting the positive terms into one sum, and the negative into another, may also be expressed thus

$$x^3 + 10x - (5x^2 + 15) = 0$$

then, to determine a root of the equation, we must find such a number as when substituted for x will render

$$x^3 + 10x = 5x^2 + 15.$$

Let us suppose x to have every degree of magnitude from 0 upwards in the scale of number, then $x^3 + 10x$ and $5x^2 + 15$ will both continually increase, but with different degrees of quickness, as appears from the following table.

Successive values of x.	0,	1,	2,	3,	4,	5,	6,	&c.
——— of $x^3 + 10x$.	0,	11,	28,	57,	104,	175,	276,	&c.
——— of $5x^2 + 15$.	15,	20,	35,	60,	95,	140,	195,	&c.

By inspecting this table, it appears that while x increases from 0 to a certain numerical value, which exceeds 3, the positive part of the equation, or $x^3 + 10x$, is always less than the negative part, or $5x^2 + 15$; so that the expression

$$x^3 + 10x - (5x^2 + 15), \text{ or } x^3 - 5x^2 + 10x - 15$$

must necessarily be negative.

It also appears that when x has increased beyond that numerical value, and which is evidently less than 4, the positive part of the equation, instead of being less than the negative part, is now greater, and therefore the expression

$$x^3 - 5x^2 + 10x - 15$$

is changed from a negative to a positive quantity.

247. Hence we may conclude that there is some real and determinate value of x, which is greater than 3, but less than 4, and which will render the positive and negative parts of the equation equal to one another; therefore that value of x must be a root of the proposed equation; and as what has been just now shewn in a particular case will readily apply to any equation whatever, the truth of what has been asserted at § 246 is obvious.

248. Two

Approximation.

248. Two limits, between which all the roots of any equation are contained, may be determined by the following proposition.

Let N be the greatest negative coefficient in any equation. Change the signs of the terms taken alternately, beginning with the second, and let N′ be the greatest negative coefficient after the signs are so changed. The positive roots of the equation are contained between 0 and N+1, and the negative roots between 0 and —N′—1.

Suppose the equation to be

$$x^4 - px^3 + qx^2 - rx - s = 0$$

which may be also expressed thus

$$x^4\left(1 - \frac{p}{x} + \frac{q}{x^2} - \frac{r}{x^3} - \frac{s}{x^4}\right) = 0.$$

Then, whatever be the values of the coefficients p, q, r, &c. it is evident that x may be taken so great as to render each of the quantities $\frac{p}{x}, \frac{q}{x^2}, \frac{r}{x^3}, \frac{s}{x^4}$ as small as we please, and therefore their sum, or $-\frac{p}{x}+\frac{q}{x^2}-\frac{r}{x^3}-\frac{s}{x^4}$ less than 1; but in that case the quantity

$$x^4\left(1 - \frac{p}{x} + \frac{q}{x^2} - \frac{r}{x^3} + \frac{s}{x^4}\right)$$

$$\text{or } x^4 - px^3 + qx^2 - rx + s$$

will be positive, and such, that the first term x^4 is greater than the sum of all the remaining terms, therefore also x^4+qx^2 the sum of the positive terms will be much greater than px^3+rx+s the sum of the negative terms alone.

Hence it follows, that if a number be found, which when substituted for x, renders the expression $x^4-px^3+qx^2-rx-s$ positive, and which is also such that every greater number has the same property, that number will exceed the greatest positive root of the equation.

Now, if we suppose N to be the greatest negative coefficient, it is evident that the positive part of the equation, or x^4+qx^2, is greater than px^3+rx+s, provided that x^4 is greater than Nx^3+Nx^2+Nx+N, or $N(x^3+x^2+x+1)$; but $x^3+x^2+x+1=\frac{x^4-1}{x-1}$, therefore a positive result will be obtained, if for x there be substituted a number such that $x^4 > \frac{N(x^4-1)}{x-1}$* or $x^5-x^4 > Nx^4-N$. Now this last condition will evidently be fulfilled if we take $x^5-x^4=Nx^4$, and from this equation we find $x=N+1$; but it farther appears that the same condition will also be fulfilled as often as $x^5-x^4 > Nx^4$ or $x-1 > N$, that is $x > N+1$, therefore N+1 must be a limit to the greatest positive root of the proposed equation, as was to be shewn.

249. If $-y$ be substituted for $+x$, the equation $x^4-px^3+qx^2-rx-s=0$ will be transformed into $y^4+py^3+qy^2+ry-s=0$; which equation differs from the former only in the signs of the second, fourth, &c. terms; and as the positive roots of this last equation are the same as the negative roots of the proposed equation, it is evident that their limit must be such as has been assigned.

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250. From the two preceding propositions it will not be difficult to discover, by means of a few trials, the nearest integers to the roots of any proposed numeral equation, and those being found, we may approximate to the roots continually, as in the following example:

$$x^4 - 4x^3 * - 3x + 27 = 0.$$

Here the greatest negative coefficient being 4, it follows, § 248, that the greatest positive root is less than 5. If $-y$ be substituted for x, the equation is transformed to

$$y^4 + 4y^3 * + 3y + 27 = 0$$

an equation having all its terms positive; therefore, it can have no positive roots, and consequently the proposed equation can have no negative roots; its real roots must therefore be contained between 0 and +5.

251. To determine the limits of each root in particular, let 0, 1, 2, 3, 4, be substituted successively for x; thus we obtain the following corresponding results.

Substitutions for x	0,	1,	2,	3,	4
Results	+27,	+21,	+5,	—9,	+15

Hence it appears that the equation has two real roots, one between 2 and 3, and another between 3 and 4.

252. That we may approximate to the first root, let us suppose $x=2+y$, where y is a fraction less than unity, and therefore its second, and higher powers but small in comparison to its first power; hence, in finding an approximate value of y, they may be rejected. Thus we have

$$\begin{aligned} x^4 &= +16+32y, \text{ \&c.} \\ -4x^3 &= -32-48y, \text{ \&c.} \\ -3x &= -\ 6-\ 3y \\ +27 &= +27 \\ \hline \text{Hence } 0 &= \quad 5-19y \text{ nearly} \end{aligned}$$

and $y=\frac{5}{19}=.26$, therefore, for a first approximation, we have $x=2.26$.

Let us next suppose $x=2.26+y'$, then, rejecting as before the second and higher powers of y' on account of their smallness, we have

$$\begin{aligned} x^4 &= +26.087+46.172y' \text{ \&c.} \\ -4x^3 &= -46.172-61.291y' \text{ \&c.} \\ -3x &= -\ 6.780-\ 3y' \\ +27 &= +27 \\ \hline 0 &= \ .135 \quad - 18.119y' \text{ nearly} \end{aligned}$$

Hence $y'=\frac{.135}{18.119}=.0075$ and $x=2.26+y'=2.2675$.

This value of x is true to the last figure, but a more accurate value may be obtained by supposing $x=2.675+y''$, and finding the value of y'' in the same manner as we have already found those of y' and y; and thus the

* The sign $>$ denotes that the quantities between which it is placed are unequal. Thus $a > b$, signifies that a is greater than b, and $a < c$, that a is less than c.

Approximation.

the approximation may be continued till any required degree of accuracy be obtained.

The ſecond root of the equation, which we have already found to be between 3 and 4, may be inveſtigated in the ſame manner as the firſt, and will appear to be 3.6797, the approximation being carried on to the fourth figure of the decimal, in determining each root.

253. In the preceding example we have ſhewn how to approximate to the roots of an adfected equation, but the ſame method will alſo apply to pure equations.

For example, let it be required to determine x from this equation $x^3=2$.

Becauſe x is greater than 1, and leſs than 2, but nearer to the former number than to the latter, let us aſſume $x=1+y$, then, rejecting the powers of y which exceed the firſt, we have $x^3=1+3y$, and therefore $2=1+3y$, and $y=\frac{1}{3}=.3$ nearly, hence $x=1.3$ nearly.

Let us next aſſume $x=1.3+y'$, then, proceeding as before, we find $2=2.197+5.07y'$, hence $y'=-\frac{.197}{5.07}$ $=-.039$, and $x=1.3-.039=1.26$ nearly.

To find a ſtill nearer approximation let us ſuppoſe $x=1.26+y'$, then from this aſſumption we find $y=-.000079$, and therefore $x=12.59921$, which value is true to the laſt figure.

254. By aſſuming an equation of any order with literal coefficients, a general formula may be inveſtigated, for approximating to the roots of equations belonging to that particular order.

Let us take for an example the cubic equation

$$x^3+px^2+qx+r=0,$$

and ſuppoſe that $x=a+y$, where a is nearly equal to x, and y is a ſmall fraction. Then, by ſubſtituting $a+y$ for x in the propoſed equation, and rejecting the powers of y which exceed the firſt, on account of their ſmallneſs, we have

$$a^3+pa^2+qa+r+(3a^2+2pa+q)y=0$$

Hence $y=-\frac{a^3+pa^2+qa+r}{3a^2+2pa+q}$

and $x=a-\frac{a^3+pa^2+qa+r}{3a^2+2pa+q}=\frac{2a^3+pa^2-r}{3a^2+2pa+q}$

255. Let it be required to approximate to a root of the cubic equation $x^3+2x^2+3x-50=0$. Here $p=2$ $q=3$ and $r=-50$; and by trials it appears that x is between 2 and 3, but neareſt the latter number; therefore for the firſt approximation a may be ſuppoſed$=3$, hence we find

$$x=\frac{2a^3+pa^2-r}{3a^2+2pa+q}=\tfrac{122}{42}=\tfrac{61}{21}.$$

By ſubſtituting $\frac{61}{21}$ for a in the formula, and proceeding as before, a value of x would be found more exact than the former, and ſo on we may go as far as we pleaſe.

256. The method we have hitherto employed for approximating to the roots of equations is known by the name of *The method of ſucceſſive ſubſtitutions*, and was firſt propoſed by Newton. It has been ſince improved by Lagrange, who has given it a form which has the advantage of ſhewing the progreſs made in the approximation by each operation. This improved form we now proceed to explain.

Let a denote the whole number, next leſs to the root ſought, and $\frac{1}{y}$ a fraction, which when added to a, completes the root, then $x=a+\frac{1}{y}$. If this value of x be ſubſtituted in the propoſed equation, a new equation involving y will be had, which, when cleared of fractions, will neceſſarily have a root greater than unity.

Let b be the whole number which is next leſs than that root, then, for a firſt approximation, we have $x=a+\frac{1}{b}$. But b being only an approximate value of y, in the ſame manner as a is an approximate value of x, we may ſuppoſe $y=b+\frac{1}{y'}$, then, by ſubſtituting $b+\frac{1}{y'}$, for y, we ſhall have a new equation, involving only y', which muſt be greater than unity; putting therefore b' to denote the next whole number leſs than the root of the equation involving y', we have $y=b+\frac{1}{b'}=\frac{bb'+1}{b'}$, and ſubſtituting this value in that of x the reſult is

$$x=a+\frac{b'}{bb'+1}$$

for a ſecond approximate value of x.

To find a third value we may take $y'=b'+\frac{1}{y''}$, then if b'' denote the next whole number leſs than y'', we have $y'=b'+\frac{1}{b''}=\frac{b'b''+1}{b''}$ whence

$$y=b+\frac{b''}{b'b''+1}=\frac{bb'b''+b''+b}{b'b''+1} \text{ and}$$

$$x=a+\frac{b'b''+1}{bb'b''+b''+b}$$

and ſo on to obtain more accurate approximations.

257. We ſhall apply this method to the following example

$$x^3-7x+7=0.$$

Here the poſitive roots muſt be between 0 and 8 let us therefore ſubſtitute ſucceſſively, 0, 1, 2, . . . to 8 and we obtain reſults as follow:

Subſtitutions.								
0,	1,	2,	3,	4,	5,	6,	7,	8.
Reſults.								
+7,	+1,	+1,	+13,	+43,	+97,	+181,	+301,	+463.

but as theſe reſults have all the ſame ſign, nothing can be concluded reſpecting the magnitude of the roots from that circumſtance alone. It is, however, obſervable, that while x increaſes from 0 to 1 the reſults decreaſe; but that whatever ſucceſſive magnitudes x has greater than 2, the reſults increaſe; we may therefore reaſonably conclude that if the equation have any poſitive roots they muſt be between 1 and 2. Accordingly by ſubſtituting 1.2, 1.4, 1.6, and 1.8 ſucceſſively for x we find theſe reſults $+.328$, $-.056$, $-.104$, $+.232$,

and

2

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and as there are here two changes of the signs, it follows that the equation has two positive roots, one between 1.2 and 1.4 and another between 1.6 and 1.8.

Hence it appears that to find either value of x we may assume $x=1+\frac{1}{y}$, thus, by substitution, we have

$$y^3-4y^2+3y+1=0.$$

The limit of the positive roots of this last equation is 5, and by substituting 0, 1, 2, 3, 4 successively for y, it will be found to have two, one of which is between 1 and 2, and the other between 2 and 3. Therefore for a first approximation we have

$$x=1+\tfrac{1}{1},\ x=1+\tfrac{1}{2},\ \text{that is } x=2,\ x=\tfrac{3}{2}.$$

To approach nearer to the first value of y, let us take $y=1+\frac{1}{y'}$, and therefore

$$y'^3-2y'^2-y'+1=0.$$

This last equation will be found to have only one real root between 2 and 3, from which it appears that $y=1+\frac{1}{2}=\frac{3}{2}$, and $x=1+\frac{2}{3}=\frac{5}{3}$.

Let us next suppose $y'=2+\frac{1}{y''}$, hence we find

$$y''^3-3y''^2-4y''-1=0$$

and from this equation y'' is found to be between 4 and 5. Taking the least limit we have

$$y'=2+\tfrac{1}{4}=\tfrac{9}{4},\ y=1+\tfrac{4}{9}=\tfrac{13}{9},\ x=1+\tfrac{9}{13}=\tfrac{22}{13}.$$

It is easy to continue this process by assuming $y''=4+\frac{1}{y'''}$, and so on, as far as may be judged necessary.

We return to the second value of x, which was found $=\frac{3}{2}$ by the first approximation, and which corresponds to $y=2$. Putting $y=2+\frac{1}{y'}$, and substituting this value in the equation $y^3-4y^2+3y+1=0$, which was formerly found, we get

$$y'^3+y'^2-2y'-1=0,$$

this equation, as well as the corresponding equation employed in determining the other value of x, has only one root greater than unity, which root being between 1 and 2, let us take $y'=1$, we thence find

$$y=3 \text{ and and } x=1+\tfrac{1}{3}=\tfrac{4}{3}.$$

Put $y'=1+\frac{1}{y''}$, and we thence find by substitution

$$y''^3-3y''^2-4y''-1=0$$

an equation which gives y'' between 4 and 5, hence as before,

$$y'=\tfrac{5}{4},\ y=\tfrac{14}{5},\ x=\tfrac{19}{14}.$$

That we may proceed in the approximation we have only to suppose $y''=4+\frac{1}{y'''}$, and so on. The equation x^3-7x+7 has also a negative root between -3 and -4, and to find a nearer value we may put $x=-3-\frac{1}{y}$, hence we have $y^3-20y^2-9y-1=0$, and $y>20$, $y<21$ and therefore, for the first approximation, $x=-3-\frac{1}{20}=-\frac{61}{20}$. By putting $y=20+\frac{1}{y'}$, &c. we may obtain successive values of x, each of which will be more exact than that which preceded it.

Infinite Series.

258. The successive equations which involve y, y', y'', &c. have never more than one root greater than unity, unless that two or more roots of the proposed equation are contained between the limits a, and $a+1$, but when that circumstance has place, as in the preceding example, some one of the equations involving y, y', &c. will have more than one root greater than unity, and from each root a series of equations may be derived, by which we may approximate to the particular roots of the proposed equation contained between the limits a and $a+1$.

Sect. XVII. *Of Infinite Series.*

259. The resolving of any proposed quantity into a series, is a problem of considerable importance in the application of algebra to the higher branches of the mathematics, and there are various methods by which it may be performed, suited to the particular forms of the quantities which may become the subject of consideration.

260. Any rational fraction may be resolved into a series by the common operation of algebraic division as in the following examples:

Ex. 1. To change $\frac{ax}{a-x}$ into an infinite series

Operation.

$$\begin{array}{l}
a-x)\,ax\quad\left(x+\frac{x^2}{a}+\frac{x^3}{a^2}+\frac{x^4}{a^3}+,\ \&c.\right.\\
\quad ax-x^2\\
\hline
\quad\quad +x^2\\
\quad\quad +x^2-\frac{x^3}{a}\\
\hline
\quad\quad\quad +\frac{x^3}{a}\\
\quad\quad\quad +\frac{x^3}{a}-\frac{x^4}{a^2}\\
\hline
\quad\quad\quad\quad +\frac{x^4}{a^2}
\end{array}$$

Thus it appears, that

$$\frac{ax}{a-x}=x+\frac{x^2}{a}+\frac{x^3}{a^2}+\frac{x^4}{a^3}+,\ \&c.$$

Here the law of the series being evident, the terms may be continued at pleasure.

Ex. 2. It is required to convert $\frac{a^2}{(a+x)^2}$ into an infinite series

Infinite Series.

$$a^2+2ax+x^2)\,a^2\,\left(1-\frac{2x}{a}+\frac{3x^2}{a^2}-\frac{4x^3}{a^3}+\text{, \&c.}\right.$$

$$\begin{array}{r}a^2+2ax+x^2\\ \hline -2ax-x^2\\ -2ax-4x^2-\frac{2x^3}{a}\\ \hline +3x^2+\frac{2x^3}{a}\\ +3x^2+\frac{6x^3}{a}+\frac{3x^4}{a^2}\\ \hline -\frac{4x^3}{a}-\frac{3x^4}{a^2}\end{array}$$

Therefore $\frac{a^2}{(a+x)^2}=1-\frac{2x}{a}+\frac{3x^2}{a^2}-\frac{4x^3}{a^3}+\frac{5x^4}{a^4}-$ &c. the law of continuation being evident.

261. A second method by which algebraic quantities, whether rational or irrational, may be converted into series, and which is also of very extensive use in the higher parts of the mathematics, consists in assuming a series with indeterminate coefficients, and having its terms proceeding according to the powers of some quantity contained in the proposed expression.

That we may explain this method, let us suppose that the fraction $\frac{a^2}{a^2+ax+x^2}$ is to be converted into a series proceeding by the powers of x; we are therefore to assume

$$\frac{a^2}{a^2+ax+x^2}=A+Bx+Cx^2+Dx^3+Ex^4+\text{, \&c.}$$

where A denotes these terms of the series into which x does not at all enter; Bx the terms which contain only the first power of x; Cx^2 the terms which contain only the second power, and so on. Let both sides of the equation be multiplied by a^2+ax+x^2 so as to take away the denominator of the fraction, and let the numerator a^2 be transposed to the other side, so that the whole expression may be $=0$, then

$$\left.\begin{array}{l}a^2A+a^2B\\-a^2+aA\end{array}\right\}x\left.\begin{array}{l}+a^2C\\+aB\\+A\end{array}\right\}x^2\left.\begin{array}{l}+a^2D\\+aC\\+B\end{array}\right\}x^3\left.\begin{array}{l}+a^2E\\+aD\\+C\end{array}\right\}x^4+\text{, \&c.}\right\}=0.$$

Now the quantities A, B, C, D, &c. being supposed to be entirely independent of any particular value of x, it follows that the whole expression can only be $=0$, upon the supposition that the terms which multiply the same powers of x are separately $=0$; for if that were not the case, it would follow that x had a certain determinate relation to the quantities A, B, C, &c. which is contrary to what we have all along supposed. To determine the quantities A, B, C, D, &c. therefore, we have this series of equations

$$\begin{array}{ll}a^2A-a^2=0 & \text{Hence } A=1\\ a^2B+aA=0 & B=-\frac{A}{a}=-\frac{1}{a}\\ a^2C+aB+A=0 & C=-\frac{B}{a}-\frac{A}{a^2}=0\\ a^2D+aC+B=0 & D=-\frac{C}{a}-\frac{B}{a^2}=\frac{1}{a^3}\\ a^2E+aD+C=0 & E=-\frac{D}{a}-\frac{C}{a^2}=-\frac{1}{a^4}\\ \text{\&c.} & \text{\&c.}\end{array}$$

Here the law of relation which takes place among the quantities A, B, C, D, &c. is evident, viz. that if P, Q, R, denote any three coefficients which immediately follow each other

$$a^2R+aQ+P=0$$

and from this equation, by means of the coefficients already determined, we find $F=0$, $G=\frac{1}{a^6}$, $H=-\frac{1}{a^7}$, $K=0$, &c.

Therefore, resuming the assumed equation, and substituting for A, B, C, &c. their respective values, we have

$$\frac{a^2}{a^2+ax+x^2}=1-\frac{x}{a}\ast+\frac{x^3}{a^3}-\frac{x^4}{a^4}\ast+\frac{x^6}{a^6}-\frac{x^7}{a^7}\ast+\text{, \&c.}$$

262. As a second example of the method of indeterminate coefficients, let it be required to express the square root of a^2-x^2 by means of a series. For this purpose we might assume

$$\sqrt{a^2-x^2}=A+Bx+Cx^2+Dx^3+Ex^4+\text{, \&c.}$$

but as we would find the coefficients of the odd powers of x, each $=0$, let us rather assume

$$\sqrt{a^2-x^2}=A+Bx^2+Cx^4+Dx^6+\text{, \&c.}$$

then, squaring both sides, and transposing, we have

$$0=\left\{\begin{array}{l}A^2\\-a^2\end{array}\begin{array}{l}+2AB\\+1\end{array}\right\}x^2\left.\begin{array}{l}+2AC\\+B^2\end{array}\right\}x^4\left.\begin{array}{l}+2AD\\+2BC\end{array}\right\}x^6+\text{, \&c.}$$

$$\begin{array}{ll}\text{Hence } A^2-a^2=0 & \text{and } A=a\\ 2AB+1=0 & B=-\frac{1}{2A}=-\frac{1}{2a}\\ 2AC+B^2=0 & C=-\frac{B^2}{2A}=-\frac{1}{8a^3}\\ AD+BC=0 & D=-\frac{BC}{A}=-\frac{1}{16a^5}\\ \text{\&c.} & \text{\&c.}\end{array}$$

and substituting for A, B, C, &c. their values

$$\sqrt{a^2-x^2}=a-\frac{x^2}{2a}-\frac{x^4}{8a^3}-\frac{x^6}{16a^5}-\text{, \&c.}$$

This method of resolving a quantity into an infinite series will be found more expeditious than any other, as often as the operations of division and evolution are to be performed at the same time, as in these expressions $\frac{1}{\sqrt{a^2+x^2}}$, or $\frac{\sqrt{a^2-x^2}}{\sqrt[3]{a^3+x^3}}$.

263. The binomial theorem affords a third method of resolving quantities into series, but before we explain this method it will be proper to shew how the theorem itself may be investigated.

Let $a+x$ be any binomial quantity, which is to be raised

raised to a power denoted by $\frac{m}{n}$, where m and n denote any numbers either positive or negative. Or because $a+x=a\left(1+\frac{x}{a}\right)$, if we put $\frac{x}{a}=y$, then $(a+x)^{\frac{m}{n}}$ $=a^{\frac{m}{n}}\times(1+y)^{\frac{m}{n}}$; therefore instead of $a+x$ we may consider $1+y$, which is somewhat more simple in its form.

264. By considering some of the first powers of $1+x$, viz.

$$\begin{aligned}(1+x) &= 1+x\\ (1+x)^2 &= 1+2x+x^2\\ (1+x)^3 &= 1+3x+3x^2+x^3\\ (1+x)^4 &= 1+4x+6x^2+4x^3+x^4\\ &\text{\&c.}\end{aligned}$$

it appears that the powers of $1+x$ have this form

$$1+Ax+Bx^2+Cx^3+Dx^4+, \text{ \&c.}$$

where the coefficients A, B, C, D, &c. are numbers which are altogether independent of any particular value of x. It also appears that the series cannot contain any negative power of x; for if any of its terms had this form $\frac{Q}{x^r}$, then, the supposition of $x=0$ would render that term indefinitely great, whereas the whole series ought in that case to be reduced to unity.

265. Let us therefore assume

$$(+y)^{\frac{m}{n}}=1+Ay+By^2+Cy^3+Dy^4+, \text{ \&c.}$$

Then we have also

$$(1+z)^{\frac{m}{n}}=1+Az+Bz^2+Cz^3+Dz^4+, \text{ \&c.}$$

Let us put $(1+y)^{\frac{1}{n}}=u$, $(1+z)^{\frac{1}{n}}=v$, and therefore $(1+y)^{\frac{m}{n}}=u^m$, $(1+z)^{\frac{m}{n}}=v^m$, then, taking the difference between the two series, we have

$$u^m-v^m=A(y-z)+B(y^2-z^2)+C(y^3-z^3)+D(y^4-z^4)+, \text{ \&c.}$$

Because $u^n=1+y$ and $v^n=1+z$, by subtracting the latter equation from the former, $u^n-v^n=y-z$, hence, and from the last series, we have

$$\frac{u^m-v^m}{u^n-v^n}=\frac{A(y-z)}{y-z}+\frac{B(y^2-z^2)}{y-z}+\frac{C(y^3-z^3)}{y-z}+\frac{D(y^4-z^4)}{y-z}+, \text{ \&c.}$$

266. But every expression of the form u^m-v^m is divisible by $u-v$, when m is a whole number, thus we have

$$u^m-v^m=(u-v)(u^{m-1}+u^{m-2}v\ldots+uv^{m-2}+v^{m-1})$$
$$u^n-v^n=(u-v)(u^{n-1}+u^{n-2}v\ldots+uv^{n-2}+v^{n-1})$$

so that if we substitute for $\frac{u^m-v^m}{u^n-v^n}$ its value, as found from these equations, and divide each term of the series by the denominator $y-z$ we have

$$\frac{u^{m-1}+u^{m-2}v\ldots+uv^{m-2}+v^{m-1}}{u^{n-1}+u^{n-2}v\ldots+uv^{n-2}+v^{n-1}}=$$
$$A+B(y+z)+C(y^2+yz+z^2)+D(y^3+y^2z+yz^2+z^3)+E(y^4+y^3z+y^2z^2+yz^3+z^4)+, \text{ \&c.}$$

Now as this last equation must be true, whatever be the values of y and z, we may suppose $y=z$, but in that case $1+y=1+z$ or $u^n=v^n$, and therefore $u=v$. Thus the equation is reduced to

$$\frac{mu^{m-1}}{nu^{n-1}}=A+2By+3Cy^2+4Dy^3+5Ey^4+, \text{ \&c.}$$

or to the following:

$$\frac{m}{n}u^m=u^n(A+2By+3Cy^2+4Dy^3+5Ey^4+, \text{ \&c.}),$$

so that, putting for u^m and u^n their values $(1+y)^{\frac{m}{n}}$ and $1+y$ we have

$$\begin{aligned}\frac{m}{n}(1+y)^{\frac{m}{n}} &= (1+y)(A+2By+3Cy^2+4Dy^3+5Ey^4+, \text{ \&c.})\\ &=\begin{cases}A+2By+3Cy^2+4Dy^3+5Ey^4+, \text{ \&c.}\\ \quad+Ay+2By^2+3Cy^3+4Dy^4+, \text{ \&c.}\end{cases}\end{aligned}$$

But from the equation originally assumed we have

$$\frac{m}{n}(1+y)^{\frac{m}{n}}=\frac{m}{n}+\frac{m}{n}Ay+\frac{m}{n}By^2+\frac{m}{n}Cy^3+\frac{m}{n}y^4+, \text{ \&c.}$$

therefore

$$\frac{m}{n}+\frac{m}{n}Ay+\frac{m}{n}By^2+\frac{m}{n}Cy^3+\frac{m}{n}Dy^4+, \text{ \&c.}$$
$$=\begin{cases}A+2By+3Cy^2+4Dy^3+5Ey^4+, \text{ \&c.}\\ \quad+Ay+2By^2+3Cy^3+4Dy^4+, \text{ \&c.}\end{cases}$$

And as the coefficients of the terms have no connexion with any particular value of y, it follows, that the coefficient of any power of y on the one side of the equation must be equal to the coefficient of the same power of y on the other side. Therefore, to determine A, B, C, &c. we have the following series of equations:

Infinite Series.

$A=\frac{m}{n}$ Hence $A=\frac{m}{n}$

$2B+A=\frac{m}{n}A$ $B=\frac{A\left(\frac{m}{n}-1\right)}{2}=\frac{A(m-n)}{2n}$

$3C+2B=\frac{m}{n}B$ $C=\frac{B\left(\frac{m}{n}-2\right)}{3}=\frac{B(m-2n)}{3n}$

$4D+3C=\frac{m}{n}C$ $D=\frac{C\left(\frac{m}{n}-3\right)}{4}=\frac{C(m-3n)}{4n}$

$5E+4D=\frac{m}{n}D$ $E=\frac{D\left(\frac{m}{n}-4\right)}{5}=\frac{D(m-4n)}{5n}$

&c. &c.

Or, substituting for A, B, C, &c. their values as determined from the preceding equations:

$$A=\frac{m}{n}$$

$$B=\frac{m(m-n)}{1.2\,n^2}$$

$$C=\frac{m(m-n)(m-2n)}{1.2.3\,n^3}$$

$$D=\frac{m(m-n)(m-2n)(m-3n)}{1.2.3.4\,n^4}$$

$$E=\frac{m(m-n)(m-2n)(m-3n)(m-4n)}{1.2.3.4.5\,n^5}$$

&c.

267. Resuming now the assumed equation,

$$(1+y)^{\frac{m}{n}}=1+Ay+By^2+Cy^3+, \&c.$$

And observing that $\frac{x}{a}=y$ and $(a+x)^{\frac{m}{n}}=a^{\frac{m}{n}}(1+y)^{\frac{m}{n}}$ we have

$$(a+x)^{\frac{m}{n}}=a^{\frac{m}{n}}\left(1+\frac{m}{n}\frac{x}{a}+\frac{A(m-n)}{2n}\frac{x^2}{a^2}+\frac{B(m-2n)}{3n}\frac{x^3}{a^3}+\frac{C(m-3n)}{4n}\frac{x^4}{a^4}+, \&c.\right)$$

where A, B, C, &c. denote the coefficients of the preceding terms, or

$$(a+x)^{\frac{m}{n}}=a^{\frac{m}{n}}+\frac{m}{n}a^{\frac{m-n}{n}}x+\frac{m(m-n)}{1.2\,n^2}a^{\frac{m-2n}{n}}x^2+\frac{m(m-n)(m-2n)}{1.2.3\,n^3}a^{\frac{m-3n}{n}}x^3$$
$$+\frac{m(m-n)(m-2n)(m-3n)}{1.2.3.4\,n^4}a^{\frac{m-4n}{n}}x^4+, \&c.$$

and either of these formulæ may be considered as a general theorem for raising a binomial quantity $a+x$ to any power whatever.

268. In determining the value of the expression $\frac{u^m-v^m}{u^n-v^n}$ when $u=v$ it has been taken for granted that $\frac{m}{n}$ is positive, but the same conclusion will be obtained when $\frac{m}{n}$ is negative. For, changing $+m$ into $-m$, and observing that

$$u^{-m}-v^{-m}=\frac{1}{u^m}-\frac{1}{v^m}=\frac{v^m-u^m}{u^mv^m}$$

we have

$$\frac{u^{-m}-v^{-m}}{u^n-v^n}=\frac{1}{u^mv^m}\left(\frac{v^m-u^m}{u^n-v^n}\right)=-\frac{1}{u^mv^m}\left(\frac{u^m-v^m}{u^n-v^n}\right)$$

Now we have already found, that when $u=v$, the fraction $\frac{u^m-v^m}{u^n-v^n}$ becomes $\frac{mu^{m-1}}{nu^{n-1}}$, therefore in the same case

$$\frac{u^{-m}-v^{-m}}{u^n-v^n}=\frac{-1}{u^{2m}}\times\frac{mu^{m-1}}{nu^{n-1}}=\frac{-mu^{-m-1}}{nu^{n-1}}$$

and from this last expression we derive the same value for u^{-m} or $(1+y)^{\frac{-m}{n}}$ as before, regard being had to the change of the sign of the exponent.

269. If we suppose m to be a positive integer, and $n=1$ the series given in last article for the powers of $a+x$ will always terminate, as appears also from the operation of involution; but if m be negative, or $\frac{m}{n}$ a fraction, the series will consist of an indefinite number of terms. Examples of the application of the theorem have been already given upon the first supposition, when treating of involution; we now proceed to shew how it is to be applied to the expansion of algebraic quantities into series upon either of the two last hypotheses.

270. *Ex.* 1. It is required to express $\frac{r^3}{(r+z)^3}$ by means of a series.

Because $\frac{r}{r+z}=\frac{1}{1+\frac{z}{r}}$,

Therefore $\frac{r^3}{(r+z)^3}=\frac{1}{\left(1+\frac{z}{r}\right)^3}=\left(1+\frac{z}{r}\right)^{-3}$

Let $\left(1+\frac{z}{r}\right)^{-3}$ be compared with $(a+x)^{\frac{m}{n}}$ and we have

$$a=1,\ x=\frac{z}{r},\ m=-3,\ n=1.$$

Hence, by substituting these values of a, x, m, n in the first general formula of (§ 267) we have

$$\frac{r^3}{(r+z)^3}\begin{cases}=1-\frac{3z}{r}+\frac{3.4z^2}{1.2r^2}-\frac{3.4.5z^3}{1.2.3r^3}+, \&c.\\ =1-\frac{3z}{r}+\frac{6z^2}{r^2}-\frac{10z^3}{r^3}-\frac{15z^4}{r^4}+, \&c.\end{cases}$$

Ex. 2.

Ex. 2. It is required to express $\sqrt[3]{a+b}$ by the form of a series.

Because $a+b=a\left(1+\frac{b}{a}\right)$

Therefore $\sqrt[3]{a+b}=\sqrt[3]{a}\times\sqrt[3]{1+\frac{b}{a}}=a^{\frac{1}{3}}\left(1+\frac{b}{a}\right)^{\frac{1}{3}}$

By comparing $\left(1+\frac{b}{a}\right)^{\frac{1}{3}}$ with $(a+x)^{\frac{m}{n}}$ we have $a=1$, $x=\frac{b}{a}$, $m=1$, $n=3$,

and substituting as in last example

$$\sqrt[3]{a+b}\begin{cases}=a^{\frac{1}{3}}\left(1+\frac{1.b}{3a}-\frac{1.2b^2}{3.6a^2}+\frac{1.2.5b^3}{3.6.9a^3}-\frac{1.2.5.8b^4}{3.6.9.12a^4}+,\&c.\right)\\ =a^{\frac{1}{3}}\left(1+\frac{b}{3a}-\frac{b^2}{9a^2}+\frac{5b^3}{81a^3}-\frac{10b^4}{243a^3}+,\&c.\right)\end{cases}$$

Ex. 3. It is required to resolve $\frac{r^2}{(r^3+z^3)^{\frac{2}{3}}}$ into a series.

Because $\frac{r^2}{(r^3+z^3)^{\frac{2}{3}}}=r^2\times(r^3+z^3)^{-\frac{2}{3}}$ if we raise r^3+z^3 to the $-\frac{2}{3}$ power, and multiply the resulting series by r^2, we shall have the series required. Or the given quantity may be reduced to a more simple form thus; because $r^3+z^3=r^3\times\left(1+\frac{z^3}{r^3}\right)$

Therefore $(r^3+z^3)^{\frac{2}{3}}=r^2\left(1+\frac{z^3}{r^3}\right)^{\frac{2}{3}}$, and

$\frac{r^2}{(r^3+z^3)^{\frac{2}{3}}}=\frac{1}{\left(1+\frac{z^3}{r^3}\right)^{\frac{2}{3}}}=\left(1+\frac{z^3}{r^3}\right)^{-\frac{2}{3}}$. Hence

$$\frac{r^2}{(r^3+z^3)^{\frac{2}{3}}}\begin{cases}=\left(1+\frac{z^3}{r^3}\right)^{-\frac{2}{3}}\\ =1-\frac{2z^3}{3r^3}+\frac{2.5z^6}{3.6r^6}-\frac{2.5.8z^9}{3.6.9r^9}+\frac{2.5.8.11z^{12}}{3.6.9.12r^{12}}-,\&c.\\ =1-\frac{2z^3}{3r^3}+\frac{5z^6}{9}-\frac{40z^9}{81r^9}+\frac{110z^{12}}{243r^{12}}-,\&c.\end{cases}$$

Ex. 4. It is required to find a series equal to $\frac{\sqrt{a^2+x^2}}{\sqrt{a^2-x^2}}$.

First by the binomial theorem we have

$$\sqrt{a^2+x^2}=(a^2+x^2)^{\frac{1}{2}}=a+\frac{x^2}{2a}-\frac{x^4}{8a^3}+\frac{x^6}{16a^5}-,\&c.$$

$$\frac{1}{\sqrt{a^2-x^2}}=(a^2-x^2)^{-\frac{1}{2}}=\frac{1}{a}+\frac{x^2}{2a^3}+\frac{3x^4}{8a^5}+\frac{5x^6}{16a^7}+,\&c.$$

Therefore, by taking the product of the two series, and proceeding in the operation only to such terms as involve the 6th power of x, we find

$$\frac{\sqrt{a^2+x^2}}{\sqrt{a^2-x^2}}=1+\frac{x^2}{a^2}-\frac{x^4}{2a^4}+\frac{x^6}{2a^6},\ \&c.$$

SECT. XVIII. *Of the Reversion of Series.*

271. THE method of indeterminate coefficients, which we have already employed when treating of infinite series, may also be applied to what is called the reverting of series; that is, having any quantity expressed by an infinite series composed of the powers of another quantity, to express, on the contrary, the latter quantity by means of an infinite series composed of the powers of the former.

272. Let $y=n+ax+bx^2+cx^3+dx^4+$, &c.

Then to revert the series we must find the value of x in terms of y. For this purpose we shall transpose n, and put $z=y-n$, then

$$z=ax+bx^2+cx^3+dx^4+,\ \&c.$$

Now when $x=0$, it is evident that $z=0$, therefore we may assume for x a series of this form

$$x=Az+Bz^2+Cz^3+Dz^4+,\ \&c.$$

where the coefficients A, B, C, D, &c. denote quantities as yet unknown, but which are entirely independent of the quantity x. To determine those quantities let the first, second, third, &c. powers of the series

$$Az+Bz^2+Cz^3+Dz^4+,\ \&c.$$

be

be found by multiplication, and fubftituted for x, x^2, x^3, &c. refpectively, in the equation

$$0=-z+ax+bx^2+cx^3+, \&c.$$

thus we have

$$\left.\begin{array}{l} -z=-z \\ +ax=aAz+aBz^2+aCz^3+aDz^4+\&c. \\ +bx^2=\quad +bA^2z^2+2bABz^3+2bACz^4+\&c. \\ \qquad\qquad\qquad\qquad +bB^2z^4 \\ +cz^3=\qquad\quad +cA^3z^3+3cA^2Bz^4+\&c. \\ +dz^4=\qquad\qquad\qquad +dA^4z^4+\&c. \\ \&c. \end{array}\right\}=0$$

and, putting the coefficients of z, z^2, z^3, &c. each $=0$,

$$aA-1=0,\ aB+bA^2=0,\ aC+2bAB+cA^3=0$$
$$aD+2bAC+bB^2+3cA^2B+dA^4=0, \&c.$$

thefe equations give

$$A=\frac{1}{a}$$

$$B=-\frac{b}{a^3}$$

$$C=\frac{2b^2-ac}{a^5}$$

$$D=-\frac{5b^3-5abc+a^2d}{a^7}$$

&c.

$$\text{Therefore } x=\frac{1}{a}z-\frac{b}{a^3}z^2+\frac{2b^2-ac}{a^5}z^3$$
$$-\frac{5b^3-5abc+a^2d}{a^7}z^4+, \&c.$$

273. As an example of the application of this formula, let it be required to determine x from the equation

$$y=x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+, \&c.$$

In this cafe we have

$$z=y,\ a=1,\ b=-\tfrac{1}{2},\ c=\tfrac{1}{3},\ d=-\tfrac{1}{4}, \&c.$$

Therefore, fubftituting thefe values, we have

$$x=y+\frac{y^2}{2}+\frac{y^3}{6}+\frac{y^4}{24}+, \&c.$$

274. In the equation

$$ay+by^2+cy^3+, \&c. =a'x+b'x^2+c'x^3+, \&c.$$

in which both fides are expreffed by feries, and it is required to find y in terms of x, we muft affume, as before,

$$y=Ax+Bx^2+Cx^3+Dx^4+, \&c.$$

and fubftitute this feries and its powers for y and its powers in the propofed equation, afterwards, by bringing all the terms to one fide, and making the coefficients of each power of y, $=0$, a feries of equations will be had by which the quantities A, B, C, D, &c. may be determined.

SECT. XIX. *Of Logarithms and Exponential Quantities.*

275. ALL pofitive numbers may be confidered as powers of any one given affirmative number. The

powers of 2 for inftance may become equal, either exactly, or nearer than by any affignable difference, to all numbers whatever, from 0 upwards. If the exponents be integers we fhall have only the numbers which form the geometrical progreffion 1, 2, 4, 8, 16, &c. but the intermediate numbers may be expreffed, at leaft nearly, by means of fractional exponents. Thus the numbers from 0 to 10 may be expreffed by the powers of 2 as follows:

$2^{0}=1$	$2^{2.585}=6$
$2^{1}=2$	$2^{2.807}=7$
$2^{1.585}=3$	$2^{3.}=8$
$2^{2}=4$	$2^{3.170}=9$
$2^{2.322}=5$	$2^{3.322}=10$

In like manner may fractions be expreffed by the powers of 2. Thus

$$\cdot1=\frac{1}{2^{3.322}}=2^{-3.322},\ \cdot2=\frac{1}{2^{2.322}}=2^{-2.322},$$

$$\cdot3=\frac{1}{2^{1.737}}=2^{-1.737}, \&c.$$

where it is obfervable that the exponents are now negative.

In the fame manner may all numbers be expreffed by the powers of 10. Thus

$10^{0}=1$	$10^{-1}=\cdot1$
$10^{\cdot301}=2$	$10^{-\cdot699}=\cdot2$
$10^{\cdot477}=3$	$10^{-\cdot523}=\cdot3$
&c.	&c.

276. Even a fraction might be taken in place of 2, or 10, in the preceding examples, and fuch exponents might be found as would give its powers equal to all numbers from 0 upwards. There are therefore no limitations with refpect to the magnitude of the number, by the powers of which all other numbers are to be expreffed, except that it muft neither be equal to unity, nor negative. If it were $=1$, then all its powers would alfo be $=1$, and if it were negative, there are numbers to which none of its powers could poffibly be equal.

277. If therefore y denote any number whatever, and r a given number, a number x may be found, fuch, that $r^x=y$, and x, that is the exponent of r which gives a number equal to y, is called the *logarithm* of y.

278. The given number r, by the powers of which all other numbers are expreffed, is called the *radical number* of the logarithms which are the indices of thofe powers.

279. From the preceding definition of logarithms their properties are eafily deduced, as follows:

1. The fum of two logarithms is equal to the logarithm of their product. Let y and y' be two numbers, and x and x' their logarithms, fo that $r^x=y$, and $r^{x'}=y'$, then $r^x\times r^{x'}=yy'$, or $r^{x+x'}=yy'$, hence, from the definition, $x+x'$ is the logarithm of yy', that is the fum of the logarithms of y and y' is the logarithm of yy'.

2. The difference of the logarithms of two numbers is equal to the logarithm of their quotient; for if

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if $r^x=y$ and $r^{x'}=y'$, then $\frac{r^x}{r^{x'}}=\frac{y}{y'}$ or $r^{x-x'}=\frac{y}{y'}$, therefore, by the definitien, $x-x'$ is the logarithm of $\frac{y}{y'}$; that is the difference of the logarithms of y and y' is the logarithm of $\frac{y}{y'}$.

3. Let n be any number whatever, then, log. $\mathrm{N}^n=n \times$ log. N. For N^n is N multiplied into itſelf n times, therefore the logarithm of N^n is equal the logarithm of N added to itſelf n times, or to $n \times$ log. N.

280. From theſe properties of logarithms it follows, that if we poſſeſs tables by which we can aſſign the logarithm correſponding to any given number, and alſo the number correſponding to any given logarithm, the operations of multiplication and diviſion of numbers may be reduced to the addition and ſubtraction of their logarithms, and the operations of involution and evolution to the more ſimple operations of multiplication and diviſion. Thus if two numbers x and y are to be multiplied together, by taking the ſum of their logarithms, we obtain the logarithm of their product, and, by inſpecting the table, the product itſelf. A ſimilar obſervation applies to the quotient of two numbers and alſo to any power or to any root of a number.

281. The general properties of logarithms are independent of any particular value of the radical number, and hence there may be various ſyſtems of logarithms, according to the radical number employed in their conſtruction. Thus if the radical number be 10, we ſhall have the *common* ſyſtem of logarithms, but if it were 2·7182818 we ſhould have the logarithms firſt conſtructed by Lord Napier, which are called *hyperbolic logarithms*.

282. We have already obſerved (§ 277), that the relation between any number and its logarithm is expreſſed by the equation $r^x=y$, where y denotes a number, x its logarithm, and r the radical number of the ſyſtem, and any two of theſe three quantities being given, the remaining one may be found. If either y or r were the quantity required, the queſtion would involve no difficulty; if, however, the exponent x were conſidered as the unknown quantity while r and y were ſuppoſed given, the equation to be reſolved would be of a different form than any that we have hitherto conſidered: Equations of this form are called *exponential* equations, to reſolve ſuch an equation is evidently the ſame thing as to determine the logarithm of a given number, and this problem we ſhall now proceed to inveſtigate.

283. We therefore reſume the equation $r^x=y$, where r, x, and y denote as before, we are to find a value of x in terms of r and y. Let us ſuppoſe $r=1+a$ and $y=1+v$, then, our equation will ſtand thus

$$(1+a)^x=1+v.$$

So that, by raiſing both ſides to the power n, where n denotes an indefinite number, which is to diſappear in the courſe of the inveſtigation, we have $(1+a)^{nx}=(1+v)^n$, and reſolving both ſides of the equation into ſeries by means of the binomial theorem,

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$$1+nxa+\frac{nx(nx-1)}{1\cdot 2}a^2+\frac{nx(nx-1)(nx-2)}{1\cdot 2\cdot 3}a^3+\frac{nx(nx-1)(nx-2)(nx-3)}{1\cdot 2\cdot 3\cdot 4}a^4+, \&c.$$

$$=1+nv+\frac{n(n-1)}{1\cdot 2}v^2+\frac{n(n-1)(n-2)}{1\cdot 2\cdot 3}v^3+\frac{n(n-1)(n-2)(n-3)}{1\cdot 2\cdot 3\cdot 4}v^4+, \&c.$$

Therefore, ſubtracting unity from both ſides, and dividing by n, we have

$$xa+\frac{x(nx-1)}{1\cdot 2}a^2+\frac{x(nx-1)(nx-2)}{1\cdot 2\cdot 3}a^3+\frac{x(nx-1)(nx-2)(nx-3)}{1\cdot 2\cdot 3\cdot 4}a^4+, \&c.$$

$$=v+\frac{n-1}{1\cdot 2}v^2+\frac{(n-1)(n-2)}{1\cdot 2\cdot 3}v^3+\frac{(n-1)(n-2)(n-3)}{1\cdot 2\cdot 3\cdot 4}v^4+, \&c.$$

and by ſuppoſing the factors which conſtitute the terms of each ſeries to be actually multiplied, and the products arranged according to the powers of n, the laſt equation will have this form

$$xa+\left(\mathrm{P}n-\frac{x}{2}\right)a^2+\left(\mathrm{P}'n+\mathrm{Q}n^2+\frac{x}{3}\right)a^3+\left(\mathrm{P}''n+\mathrm{Q}'n^2+\mathrm{R}n^3-\frac{x}{4}\right)a^4+, \&c.$$

$$=v+(pn-\tfrac{1}{2})v^2+(p'n+qn^2+\tfrac{1}{3})v^3+(p''n+q'n^2+rn^3-\tfrac{1}{4})v^4+, \&c.$$

Here the coefficients of the powers of n, viz. P, P′, P″, &c. Q, Q′, &c. R, &c. alſo p, p', p'', &c. q, q', &c. r, &c. are expreſſions which denote certain combinations of the powers of x in the firſt ſeries, and certain numbers in the ſecond; but as they are all to vaniſh in the courſe of the inveſtigation, it is not neceſſary that they ſhould be expreſſed in any other way than by a ſingle letter.

284. Now each ſide of this laſt equation may evidently be reſolved into two parts, one of which is entirely free from the quantity n, and the other involves that quantity, hence the ſame equation may alſo ſtand thus,

$$\left.\begin{array}{l} xa-\frac{x}{2}a^2+\frac{x}{3}a^3-\frac{x}{4}a^4+, \&c. \\ +\mathrm{P}na^2+(\mathrm{P}'n+\mathrm{Q}n^2)a^3+(\mathrm{P}''n+\mathrm{Q}'n^2+\mathrm{R}n^3)a^4+, \&c. \end{array}\right\}$$

$$=\left\{\begin{array}{l} +v-\frac{1}{2}v^2+\frac{1}{3}v^3-\frac{1}{4}v^4+, \&c. \\ +pnv^2+(p'n+qn^2)v^3+(p''n+q'n^2+rn^4)v^4+\&c. \end{array}\right.$$

This equation muſt hold true, whatever be the value of n, which is a quantity entirely arbitrary, and therefore ought to vaniſh from the equation expreſſing the relation between x and v; hence it follows that the terms on each ſide of the equation, which involve n, ought to deſtroy each other, and thus there will remain

main only the part of each ſide, which does not involve n, that is

$$xa-\frac{xa^2}{2}+\frac{xa^3}{3}-\frac{xa^4}{4}+, \&c. = v-\frac{v^2}{2}+\frac{v^3}{3}-\frac{v^4}{4}+, \&c.$$

or $$\left(a-\frac{a^2}{2}+\frac{a^3}{3}-\frac{a^4}{4}+, \&c.\right)x = v-\frac{v^2}{2}+\frac{v^3}{3}-\frac{v^4}{4}+\frac{v^5}{5}-, \&c.$$

Let us now put A to denote the conſtant multiplier

$$a-\frac{a^2}{2}+\frac{a^3}{3}-\frac{a^4}{4}+, \&c. = (r-1)-\frac{(r-1)^2}{2}+\frac{(r-1)^3}{3}-\frac{(r-1)^4}{4}+, \&c.$$

and ſubſtitute for v, its value $y-1$, thus we at laſt find

$$x=\log. y=\frac{1}{A}\left(y-1-\frac{(y-1)^2}{2}+\frac{(y-1)^3}{3}-\frac{(y-1)^4}{4}+, \&c.\right)$$

and by this formula the logarithm of any number a little greater than unity may be readily found.

285. If y be nearly $=2$ the ſeries will, however, converge too ſlowly to be of uſe, and if it exceed 2, the ſeries will diverge, and therefore cannot be directly applied to the finding of its logarithm. But a ſeries which ſhall converge faſter and be applicable to every caſe may be inveſtigated as follows:

Becauſe $\log. (1+v)=\frac{1}{A}\left(v-\frac{v^2}{2}+\frac{v^3}{3}-\frac{v^4}{4}+, \&c.\right)$ By ſubſtituting $-v$ for $+v$ we have

$$\log. (1-v)=\frac{1}{A}\left(-v-\frac{v^2}{2}-\frac{v^3}{3}-\frac{v^4}{4}-, \&c.\right)$$

Now, $\log. (1+v)-\log. (1-v)=\log. \frac{1+v}{1-v}$, therefore, ſubtracting the latter ſeries from the former we have $\log. \frac{1+v}{1-v}=\frac{1}{A}\left(2v+\frac{2v^3}{3}+\frac{2v^5}{5}+\frac{2v^7}{7}+\&c.\right)$

Put $\frac{1+v}{1-v}=y$, then $v=\frac{y-1}{y+1}$ and the laſt ſeries becomes

$$\log. y=\frac{1}{A}\left(2\frac{y-1}{y+1}+\frac{2}{3}\left(\frac{y-1}{y+1}\right)^3+\frac{2}{5}\left(\frac{y-1}{y+1}\right)^5+\&c.\right)$$

This ſeries will always converge whatever be the value of y, and by means of it the logarithms of ſmall numbers may be found with great facility.

286. When a number is compoſite, its logarithm will moſt eaſily be found, by adding together the logarithms of its factors; but if it be a prime number, its logarithm may be derived from that of ſome convenient compoſite number, either greater or leſs and an infinite ſeries. Let n be a number of which the logarithm is already found; then ſubſtituting $\frac{n+z}{n}$ for y in the laſt formula we have

$$\log. \frac{n+z}{n}=\frac{1}{A}\left(\frac{2z}{2n+z}+\frac{1}{3}\frac{2z^3}{(2n+z)^3}+\frac{1}{5}\frac{2z^5}{(2n+z)^5}+, \&c.\right)$$

But $\log. \frac{n+z}{n}=\log. (n+z)-\log. n$, therefore

$$\log. (n+z)=\log. n+\frac{1}{A}\left(\frac{2z}{2n+z}+\frac{1}{3}\frac{2z^3}{(2n+z)^3}+\frac{2z^5}{(2n+z)^5}+, \&c.\right)$$

This ſeries gives the logarithm of $n+z$ by means of the logarithm of n, and converges very faſt when n is conſiderable.

287. It appears from the ſeries which have been found for log. y in § 284 and 285, that the logarithm of a number is always the product of two quantities; one of theſe is variable, and depends upon the number itſelf, but the other, viz. $\frac{1}{A}$ is conſtant, and depends entirely on the radical number of the ſyſtem. This quantity has been called by writers on logarithms the *modulus* of the ſyſtem.

288. The moſt ſimple ſyſtem of logarithms in reſpect to facility of computation is that in which $\frac{1}{A}=1$ or $A=1$. The logarithms of this ſyſtem are the ſame as thoſe firſt invented by Napier, and are alſo called *hyperbolic logarithms*.

The hyperbolic logarithm of any numbers, y is therefore (§ 284)

$$y-1-\frac{(y-1)^2}{2}+\frac{(y-1)^3}{3}-, \&c.$$

and that of r, the radical number of any ſyſtem is

$$r-1-\frac{(r-1)^2}{2}+\frac{(r-1)^3}{3}-, \&c.$$

but this laſt ſeries is the ſame as we have denoted by A; hence it follows. that the *modulus* of any ſyſtem is the reciprocal of the hyperbolic logarithm of the radical number of that ſyſtem. Thus it appears, that the logarithms of numbers, according to any propoſed ſyſtem, may be readily found from the hyperbolic logarithm of the ſame numbers, and the hyperbolic logarithm of the radical number of that ſyſtem.

289. Let L denote the hyp. log. of any number, and l, l' the logarithms of the ſame number according to two other ſyſtems whoſe *moduli* are m and m'; then

$$l=m\mathrm{L},\ l'=m'\mathrm{L}$$

therefore $\frac{l}{m}=\frac{l'}{m'}$ and $m:m'::l:l'$

That is, the logarithms of the ſame number, according to different ſyſtems, are directly proportional to the *moduli* of thoſe ſyſtems, and therefore have a given ratio to one another.

290. We ſhall now apply the ſeries here inveſtigated to the calculation of the hyperbolic logarithm of 10, the reciprocal of which is the *modulus* of the common ſyſtem

ſyſtem of logarithms; and alſo to the calculation of the common logarithm of 2. The hyp. log. of 10 may be obtained by ſubſtituting 10 for y in the formula

$$\text{hyp. log. } y=\frac{2(y-1)}{y+1}+\frac{2}{3}\left(\frac{y-1}{y+1}\right)^3+\frac{2}{5}\left(\frac{y-1}{y+1}\right)^5+\text{\&c.}$$

but the reſulting ſeries $\frac{2\cdot 9}{11}+\frac{2\cdot 9^3}{3\cdot 11^3}+\frac{2\cdot 9^5}{5.11^5}+$, &c. converges too ſlowly to be of any practical utility, it will therefore be better to derive the logarithm of 10 from thoſe of 2 and 5. By ſubſtituting 2 in the formula we have

$$\text{hyp. log. } 2=2\left(\frac{1}{3}+\frac{1}{3\cdot 3^3}+\frac{1}{5\cdot 3^5}+\frac{1}{7\cdot 3^7}+,\ \text{\&c.}\right)$$

this ſeries converges very faſt, ſo that by reducing its terms to decimal fractions, and taking the ſum of the firſt ſeven terms we find the hyp. log. of 2 to be ·6931472.

The hyp. log. of 5 may be found in the ſame manner, but more eaſily from the formula given in § 286. For the log. of 2 being given, that of $4=2^2$ is alſo given § 279. Therefore, ſubſtituting log. 4 = 2 log. 2 for log. n, and 1 for z, in the ſeries

$$\text{hyp. log. }(n+z)=\text{hyp. log. } n+2\left(\frac{z}{2n+z}+\frac{1}{3}\frac{z^3}{(2n+z)^3}+\frac{1}{5}\frac{z^5}{(2n+z)^5}+,\ \text{\&c.}\right)$$

we have

$$\text{hyp. log. } 5=2\text{ hyp. log. } 2+2\left(\frac{1}{9}+\frac{1}{3\cdot 9^3}+\frac{1}{5\cdot 9^5}+,\ \text{\&c.}\right)$$

The firſt three terms of this ſeries are ſufficient to give the reſult true to the ſeventh decimal, ſo that we have hyp. log. 5 = 1.6094379, and

hyp. log. 10 = hyp. log. 2 + hyp. log. 5 = 2.3025851. Hence the *modulus* of the common ſyſtem of logarithms, or $\frac{1}{\text{hyp. log. } 10}$ is found = .4342945. The ſame number, becauſe of its great utility in the conſtruction of tables of logarithms, has been calculated to a much greater number of decimals. A celebrated calculator of th elaſt century, Mr A. Sharp, found it to be

0.43429448190325182765112891891660508229
4397005803666566114454.

Having found the hyp. log. of 2 to be ·6931472 the common logarithm of 2 is had immediately, by multiplying the hyp. log. of 2 by the modulus of the ſyſtem, thus we find

$$\text{com. log. } 2=4{\cdot}342945\times{\cdot}6931472={\cdot}3010300$$

291. We have already obſerved § 282, that to determine the logarithm of a given number, is the ſame problem as to determine the value of x in an equation of this form $a^x=b$, where the unknown quantity is an exponent. But in order to reſolve ſuch an equation, it is not neceſſary to have recourſe to ſeries; for a table of logarithms being once ſuppoſed conſtructed, the value of x may be determined thus. It appears from § 279, that $x\times\text{log. } a=\text{log. } b$. Hence it follows, that $x=\frac{\text{log. } b}{\text{log. } a}$. The uſe of this formula will appear in next ſection which treats of computations relative to annuities.

292. The theory of logarithms requires the ſolution of this other problem. Having given the radical number of a ſyſtem, and a logarithm, to determine the correſponding number. Or having given the equation $r^x=y$, where r, x and y denote as in § 282, to find a ſeries which ſhall expreſs y in terms of r and x.

293. For this purpoſe, let us ſuppoſe $r=1+a$, then our equation becomes $y=(1+a)^x$, which, may alſo be expreſſed thus:

$$y=[(1+a)^n]^{\frac{x}{n}}$$

where n is an indefinite quantity, which is to diſappear in the courſe of the inveſtigation.

By the binomial theorem we have

$$(1+a)^n=1+na+\frac{n(n-1)}{1\cdot 2}a^2+\frac{n(n-1)(n-2)}{1\cdot 2\cdot 3}a^3+,\text{\&c.}$$

this equation, by multiplying together the factors which compoſe the terms of the ſeries, and arranging the reſults according to the powers of n, may alſo be expreſſed thus

$$(1+a)^n=1+An+Bn^2+Cn^3+,\ \text{\&c.}$$

where it will readily appear that

$$A=a-\frac{a^2}{2}+\frac{a^3}{3}-\frac{a^4}{4}+,\ \text{\&c.}$$

as to the values of B, C, &c. it is of no importance to know them, for they will all diſappear in the courſe of the inveſtigation. Hence, by ſubſtituting for $(1+a)^n$ its value, as expreſſed by the laſt ſeries, we have

$$y=(1+An+Bn^2+Cn^3+,\ \text{\&c.})^{\frac{x}{n}}$$

and expanding the latter part of this equation by means of the binomial theorem it becomes

$$y=1+\frac{x}{n}(An+Bn^2+\text{\&c.})+\frac{x(x-n)}{1.2\ n^2}(An+Bn^2+\text{\&c.})^2+\frac{x(x-n)(x-2n)}{1\cdot 2\cdot 3n^3}(An+Bn^2+,\ \text{\&c.})^3+,\text{\&c.}$$

But $An+Bn^2+$, &c. $=n(A+Bn+$, &c.) alſo $(An+Bn^2+$, &c.$)^2=n^2(A+Bn+$, &c.$)^2$, and $(An+Bn^2+$, &c.$)^3=n^3(A+Bn+$, &c.$)^3$, &c. therefore, by leaving out of each term of the ſeries the powers of n which are common to the numerator and denominator, the equation will ſtand thus

$$y=1+x(A+Bn+,\text{\&c.})+\frac{x(x-n)}{1\cdot 2}(A+Bn+,\text{\&c.})^2+\frac{x(x-n)(x-2n)}{1\cdot 2\cdot 3}(A+Bn+,\ \text{\&c.})^3+,\ \text{\&c.}$$

Now n is here an arbitrary quantity, and ought, from the nature of the original equation, to diſappear from the value of y; the terms of the equation which are multiplied

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multiplied by n ought therefore to destroy each other; and this being the case, the equation is reduced to

$$r^x = y = 1 + \frac{xA}{1} + \frac{x^2A^2}{1\cdot 2} + \frac{x^3A^3}{1\cdot 2\cdot 3} + \frac{x^4A^4}{1\cdot 2\cdot 3\cdot 4} +, \&c.$$

and since we have found

$$A = a - \frac{a^2}{2} + \frac{a^3}{3} - \frac{a^4}{4} +, \&c.$$

$$= (r-1) - \frac{(r-1)^2}{2} + \frac{(r-1)^3}{3} - \frac{(r-1)^4}{4}.$$

It is evident from § 288 that A is the hyperbolic logarithm of the radical number of the system.

294. If in the equation $r^x = y$ we suppose $x=1$, the value of y becomes

$$r = 1 + \frac{A}{1} + \frac{A^2}{1\cdot 2} + \frac{A^3}{1\cdot 2\cdot 3} +, \&c.$$

Here the radical number is expressed by means of its hyperbolic logarithm. Again, if we suppose $x = \frac{1}{A}$, then

$$r^{\frac{1}{A}} = 1 + \frac{1}{1} + \frac{1}{1\cdot 2} + \frac{1}{1\cdot 2\cdot 3} + \frac{1}{1\cdot 2\cdot 3} +, \&c.$$

Thus it appears that the quantity $r^{\frac{1}{A}}$ is equal to a constant number, which, by taking the sum of a sufficient number of terms of the series, will be found $=$ 2.718281828459045... Let us denote this number by e, then $r^{\frac{1}{A}} = e$, and hence $r = e^A$. Now if we remark that A is the hyp. log. of r it must be evident (§ 277 and 278) that e is the radical number of the hyperbolic system of logarithms.

Again, since $r^{\frac{1}{A}} = e$, therefore $\frac{1}{A} \times \log. r = \log. e$ and $A = \frac{\log. r}{\log. e}$, here log. r and log. e denote logarithms taken according to any system whatever.

295. If we now resume the equation.

$$r^x = y = 1 + \frac{xA}{1} + \frac{x^2A^2}{1\cdot 2} + \frac{x^3A^3}{1\cdot 2\cdot 3} +, \&c.$$

and substitute for A its value $\frac{\log. r}{\log. e}$ we shall have the following general expression for any exponential quantity whatever

$$r^x = 1 + \frac{x}{1}\left(\frac{\log. r}{\log. e}\right) + \frac{x^2}{1.2}\left(\frac{\log. r}{\log. e}\right)^2 + \frac{x^3}{1\cdot 2\cdot 3}\left(\frac{\log. r}{\log. e}\right)^3 + \&c$$

which by supposing $r=e$ becomes

$$e^x = 1 + \frac{x}{1} + \frac{x^2}{1\cdot 2} + \frac{x^3}{1\cdot 2\cdot 3} +, \&c.$$

SECT. XX. *Of Interest and Annuities.*

296 THE theory of logarithms finds its application in some measure to calculations relating to interest and annuities; these we now proceed to explain. There are two hypotheses, according to either of which money put out at interest may be supposed to be improved. We may suppose that the interest, which is always proportional to the sum lent, or principal, is also proportional to the time during which the principal is employed; and on this hypothesis the money is said to be improved at *simple* interest. Or we may suppose that the interest, which ought to be paid to the lender at successive stated periods, is added to the principal instead of being actually paid, and thus their amount converted into a new principal; when money is laid out according to this second hypothesis, it is said to be improved at *compound* interest.

Compound Interest.

297. In calculations relating to interest, the things to be considered are the *principal*, or sum lent; the *rate of interest*, or sum paid for the use of 100l. for one year; the *time* during which the principal is lent; and the *amount*, or sum of the principal and interest at the end of that time.

Let p denote the principal, 1l. being the unit.
r the interest of 1l. for one year, at the given rate.
t the time, one year being the unit.
a the amount.

We shall now examine the relations which subsist between those quantities, according to each of the two hypotheses of simple and compound interest.

I. *Simple Interest.*

298. Because the interest of 1l. for one year is r, the interest of 1l. for t years must be rt, and the interest of p pounds for the same time prt, hence we have this formula

$$p + prt = a$$

from which we find

$$p = \frac{a}{1+rt} \qquad r = \frac{a-p}{pt} \qquad t = \frac{a-p}{pr}$$

As the manner of applying these formulæ to questions relating to simple interest is sufficiently obvious, we proceed to consider compound interest.

II. *Compound Interest.*

299. In addition to the symbols already assumed, let $R = 1 + r =$ amount of 1l. in one year, then, from the nature of compound interest, R is also the principal at the beginning of the second year. Now, interest being always proportional to the principal we have

$1 : r :: R : rR =$ the interest of R for a year,

and $R + rR = (1+r)R = R^2 =$ amount of R in a year, therefore R^2 is the amount of 1l. in two years, which sum being assumed as a new principal, we find, as before, its interest for a year to be rR^2, and its amount $R^2 + rR^2 = (1+r)R^2 = R^3$; so that R^3 is the amount of 1l. in three years. Proceeding in this manner we find in general that the amount of 1l. in t years is R^t, and of p pounds pR^t, hence we have this formula

$$pR^t = a$$

which

Annuities. which from the nature of logarithms may also be expressed thus:

$$\log. p + t \times \log. R = \log. a$$

Hence we find

$$p = \frac{a}{R^t} \qquad R = \sqrt[t]{\frac{a}{p}}$$

or, by logarithms,

$$\log. p = \log. a - t \times \log. R. \quad \log. R = \frac{\log. a - \log. p}{t}$$

$$t = \frac{\log. a - \log. p}{\log. R}$$

300. As an example of the use of these formulæ, let it be required to determine what sum improved at 5 *per cent.* compound interest will amount to 500l. in 42 years. In this case we have given $a=500$ $r=.05$, $R=1.05$, $t=42$, to find p.

From	$\log. a = \log. 500 =$	2.6989700
subtract	$t \times \log. R = 42 \times \log. 1.05 =$	0.8899506
remains $\log. p$		1.8090194

therefore $p = 64.42$l. $=$ 64l. 8s. 5d. the sum required.

Ex. 2. In what time will a sum laid out at 4 *per cent.* compound interest be doubled.

Let any sum be expressed by unity, then we have given $p=1$, $r=.04$, $R=1.04$, $a=2$, to find t.

From the formula $t = \frac{\log. a - \log. p}{\log. R} = \frac{\log. 2}{\log. 1.04}$

we find $t = \frac{\cdot 3010300}{\cdot 0170333} = 17.7$ years nearly.

301. In treating of compound interest we have supposed the interest to be joined to the principal at the end of every year. But we might have supposed it to be added at the end of every half year or every quarter, or even every instant, and suitable rules might have been found for performing calculations according to each hypothesis. As such suppositions are, however, never made in actual business, we shall not at present say any thing more of them.

III. *Annuities.*

302. An annuity is a payment made annually for a term of years, and the chief problem relating to it is to determine its present worth, that is the sum a person ought to pay immediately to another, upon condition of receiving from the latter a certain sum annually for a given time. In resolving this problem, it is supposed that the buyer improves his annuity from the time he receives it, and the seller the purchase money in a certain manner during the continuance of the annuity, so that at the end of the time, the amount of each may be the same. There may be various suppositions as to the way in which the annuity and its purchase money may be improved; but the only one commonly applied to practice is the highest improvement possible of both, viz. by compound interest. As the taking compound interest is, however, prohibited by law, the realising of this supposed improvement requires punctual payment of interest, and therefore the interest in such calculations is usually made low. Continued Fractions.

303. Let A denote the annuity;
P the present worth, or purchase money;
t the time of its continuance;
let r and R denote as before.

The seller, by improving the price P at compound interest during the time t, has PR^t.

The purchaser is supposed to receive the first annuity A at the end of one year, which being improved for $t-1$ years amounts to AR^{t-1}. He receives the second years annuity at the end of the second year, which being improved for $t-2$ years amounts to AR^{t-2}. In like manner the third year's annuity becomes AR^{t-3}, and so on to the last years annuity, which is simply A. Therefore, the whole amount of the improved annuities is the geometrical series.

$$A + AR + AR^2 + AR^3 \ldots + AR^{t-1}$$

the sum of which, by § 106, is $A\frac{R^t-1}{R-1} = A\frac{R^t-1}{r}$;

and since this sum must be equal to the amount of the purchase money, or PR^t, we have

$$PR^t = A\frac{R^t-1}{r}.$$

and from this equation, we find

$$P = \frac{A}{r}\left(1 - \frac{1}{R^t}\right). \quad A = \frac{rPR^t}{R^t-1}. \quad t = \frac{\log. A - \log. (A - rP)}{\log. R}.$$

As to r, it can only be found by the resolution of an equation of the t order.

304. To find the present value of an annuity in *reversion*, that is an annuity which is to commence at the end of n years, and continue during t years; first find its value for $n+t$ years, and then for n years, and subtract the latter from the former. We thus obtain the following formula

$$P = \frac{A}{rR^n}\left(1 - \frac{1}{R^t}\right).$$

305. If the annuity is to commence immediately, and to continue for ever, then, because in this case R^t is infinitely great, and therefore $\frac{1}{R^t} = 0$, the formula $P = \frac{A}{r}\left(1 + \frac{1}{R^t}\right)$ becomes simply $P = \frac{A}{r}$.

And if the annuity is to commence after n years and continue for ever, the formula $P = \frac{A}{rR^n}\left(1 - \frac{1}{R^t}\right)$ becomes $P = \frac{A}{rR^n}$.

Sect. XXI. *Of continued Fractions.*

306. Every quantity which admits of being expressed by a common fraction may also be expressed in the

Continued Fractions.

the form of what is called a *continued fraction*. The nature of ſuch fractions will be eaſily underſtood by the following example.

Let the common fraction be $\frac{314159}{100000}$, or which is the ſame $3+\frac{14159}{100000}$. Since $100000=7\times 14159+887$, therefore $\frac{14159}{100000}=\frac{14159}{7\times 14159+887}=\cfrac{1}{7+\cfrac{887}{14159}}$ and

$$\frac{314159}{100000}=3+\cfrac{1}{7+\cfrac{887}{14159}}.$$

Now $\frac{887}{14159}=\frac{887}{15\times 887+854}=\cfrac{1}{15+\cfrac{854}{887}}$, and ſubſtituting this for $\frac{887}{15159}$, in the value of $\frac{314159}{100000}$ already found we have $\frac{314159}{100000}=3+\cfrac{1}{7+\cfrac{1}{15+\cfrac{854}{887}}}$

Again, $\frac{854}{887}=\frac{854}{854+33}=\cfrac{1}{1+\cfrac{33}{854}}$, which being ſubſtituted as before, gives $\frac{314159}{100000}=3+\cfrac{1}{7+\cfrac{1}{15+\cfrac{1}{1+\cfrac{33}{854}}}}$

By operations ſimilar to the preceding we find $\frac{33}{854}=\cfrac{1}{25+\cfrac{29}{33}}$, $\frac{29}{33}=\cfrac{1}{1+\cfrac{4}{29}}$, $\frac{4}{29}=\cfrac{1}{7+\cfrac{1}{4}}$, therefore, by ſubſtitution

$$\frac{314159}{100000}=3+\cfrac{1}{7+\cfrac{1}{15+\cfrac{1}{1+\cfrac{1}{25+\cfrac{1}{1+\cfrac{1}{7+\cfrac{1}{4}}}}}}}$$

By an operation, in all reſpects the ſame as has been juſt now performed may any fraction whatever be reduced to the form

$$a+\cfrac{1}{b+\cfrac{1}{c+\cfrac{1}{d+,\ \&c.}}}$$

and it is then called a *continued fraction*.

307. It is eaſy to ſee in what manner the inverſe of the preceding operation is to be performed, or a continued fraction reduced to a common fraction.

Thus if the continued fraction be

$$a+\cfrac{1}{b+\cfrac{1}{c+\cfrac{1}{d}}}$$

it will evidently be reduced to a common fraction by adding the reciprocal of d to b, and the reciprocal of that ſum to b, and again the reciprocal of this laſt ſum to a; now the reciprocal of d, or $\frac{1}{d}$, added to c is $c+\frac{1}{d}=\frac{cd+1}{d}$, again the reciprocal of this ſum, or $\frac{d}{cd+1}$, added to b is $b+\frac{d}{cd+1}=\frac{bcd+b+d}{cd+1}$, and the reciprocal of this laſt quantity, viz. $\frac{cd+1}{bcd+b+d}$, when added to a gives

Continued Fractions.

$$\frac{abcd+ab+ad+cd+1}{bcd+b+d}=a+\cfrac{1}{b+\cfrac{1}{c+\cfrac{1}{d}}}.$$

308. This manner of expreſſing a fraction enables us to find a ſeries of other fractions, that approach in value to any given one, and each of them expreſſed in the ſmalleſt numbers poſſible. Thus in the example $\frac{314159}{100000}$ which has been reſolved into a continued fraction, § 306, and which is known to expreſs nearly the proportion of the diameter of a circle to its circumference; if we take only the firſt two terms of the continued fraction, and put π for $\frac{314159}{100000}$, we ſhall have $\pi=3+\frac{1}{7}=\frac{22}{7}$ nearly, and this is the proportion which was found by Archimedes.

Again by taking the firſt three terms we have

$$\pi=3+\cfrac{1}{7+\cfrac{1}{15}}=3+\frac{15}{106}=\frac{333}{106}$$

which is nearer the truth than the former.

And by taking the firſt four terms we have

$$\pi=3+\cfrac{1}{7+\cfrac{1}{15+\cfrac{1}{1}}}=\frac{355}{113}$$

which is the proportion aſſigned by Metius, and is more exact than either of the preceding. Theſe reſults are alternately greater and leſs than the truth.

309. Among continued fractions, thoſe have been particularly diſtinguiſhed in which the denominators, after a certain number of changes, are continually repeated in the ſame order. Such for example is the fraction

$$1+\cfrac{1}{2+\cfrac{1}{3+\cfrac{1}{2+\cfrac{1}{3}+,\ \&c.}}}$$

The amount of this fraction, though continued *ad infinitum*, may be eaſily found; for leaving out the firſt term, which is an integer, let us ſuppoſe

$$x=\cfrac{1}{2+\cfrac{1}{3+\cfrac{1}{2+\cfrac{1}{3}+,\ \&c.}}}$$

Then ſince after the ſecond, all the terms return in the

Continued Fractions.

the same order, it follows that their amount is also $=x$, thus we have

$$x=\frac{1}{2+\frac{1}{3+x}}$$

Hence $x=\frac{3+x}{6+2x+1}$ and $x^2+3x=\frac{3}{2}$ and $x=\frac{-3+\sqrt{15}}{2}$

Therefore $x+1$, or the sum of the series, $=\frac{-1+\sqrt{15}}{2}$

In general if $x=\frac{1}{a+\frac{1}{b+\frac{1}{a+}}}$, &c.

we find $x=-\frac{b}{2}\pm\sqrt{\frac{b^2}{4}+\frac{b}{a}}$. Though the denominators did not return in the same order till after a greater interval, the value of the fraction would still be expressed by the root of a quadratic equation. And conversely, the roots of all quadratic equations may be expressed by periodical continued fractions, and may often by that means be very readily approximated in numbers, without the trouble of extracting the square root.

310. The reduction of a decimal into the form of a continued fraction sometimes renders the law of its continuation evident. Thus we know that $\sqrt{2}=1.4121356\cdots$ but from the bare inspection of this decimal we discover no rule for its further continuation. If, however, it be reduced into a continued fraction, it becomes

$$=1+\frac{1}{2+\frac{1}{2+\frac{1}{2+}}}, \&c.$$

and hence we see it what way it may be continued to any degree of accuracy.

311. When the root of any equation is found by the method explained in § 256, the value of the unknown quantity is evidently expressed by a continued fraction. For if x be the root sought, we have $x=a+\frac{1}{y}$, $y=b+\frac{1}{y'}$, $y'=b'+\frac{1}{y''}$, $y''=b''+\frac{1}{y'''}$, &c. where a, b', b'', b''', &c. denote the whole numbers, which are next less than the true values of x, y, y', y'', &c. If therefore in the value of x we substitute $b+\frac{1}{y'}$, for y, it becomes

$$x=a+\frac{1}{b+\frac{1}{y'}}.$$

Again, if in this second value of x we substitute $b'+\frac{1}{y''}$ for y it becomes

$$x=a+\frac{1}{b+\frac{1}{b'+\frac{1}{y''}}}$$

The next value of x is in like manner found to be

$$x=a+\frac{1}{b+\frac{1}{b'+\frac{1}{b''+\frac{1}{y'''}}}}$$

and so on continually.

Sect. XXII. *Of Indeterminate Problems.*

Indeterminate Problems.

312. When the conditions of a question are such that the number of equations exceeds the number of unknown quantities, that question will admit of innumerable solutions, and is therefore said to be indeterminate. Thus, if it be required to find two numbers subject to no other limitation than that their sum be 10, we have two unknown quantities x and y, and only one equation, viz. $x+y=10$, which may evidently be satisfied by innumerable different values of x and y, if fractional solutions be admitted. It is, however, usual in such questions as this, to restrict the values of the numbers sought to positive integers, and therefore, in this case, we can have only these nine solutions;

$$x=1, 2, 3, 4, 5, 6, 7, 8, 9.$$
$$y=9, 8, 7, 6, 5, 4, 3, 2, 1.$$

which indeed may be reduced to five, for the first four become the same as the last four, by simply changing x into y, and the contrary.

313. Indeterminate problems are of different orders according to the dimensions of the equation which is obtained after all the unknown quantities, but two have been exterminated by means of the given equations. Those of the first order lead always to equations of this form,

$$ax+by=c,$$

where a, b, c denote given whole numbers, and x, y two numbers to be found, so that both may be integers. That this condition may be fulfilled, it is necessary that the coefficients a, b have no common divisor which is not also a divisor of c, for if $a=md$ and $b=me$, then $ax+by=mdx+mey=c$, and $dx+ey=\frac{c}{m}$; but d, e, x, y are supposed to be whole numbers, therefore $\frac{c}{m}$ is a whole number, hence m must be a divisor of c.

314. We proceed to illustrate the manner of resolving indeterminate equations of the first order by some numerical examples.

Ex. 1. Given $2x+3y=25$, to determine x and y in whole positive numbers.

From the given equation we have $x=\frac{25-3y}{2}=12-y+\frac{1-y}{2}$; now since x must be a whole number it follows that $\frac{1-y}{2}$ must be a whole number. Let us assume $\frac{1-y}{2}=z$, then $1-y=2z$ and $y=1-2z$, and since $x=12-y+\frac{1-y}{2}=12-y+z$, therefore $x=12-1+2z+z$; hence we have

$$x=11+3z, \qquad y=1-2z$$

where

where z might be any whole number whatever, if there were no limitation as to the ſigns of x and y; but ſince theſe quantities are required to be poſitive, it is evident from the value of y, that z muſt either be 0 or negative, and from the value of x that, abſtracting from the ſign, it muſt be leſs than 4; hence z may have theſe three values $0, -1, -2, -3$.

$$\begin{array}{llll} \text{If } z=0, & z=-1, & z=-2, & z=-3. \\ \text{Then} \begin{cases} x=11, \\ y=1, \end{cases} & \begin{array}{l} x=8, \\ y=3, \end{array} & \begin{array}{l} x=5, \\ y=5, \end{array} & \begin{array}{l} x=2. \\ y=7. \end{array} \end{array}$$

Ex. 2. It is required to divide 100 into ſuch parts that the one may be diviſible by 7 and the other by 11.

Let $7x$ be the firſt part, and $11y$ the ſecond, then by the queſtion $7x+11y=100$, and

$$x=\frac{100-11y}{7}=14-y+\frac{2-4y}{7};$$

hence it appears that $\frac{2-4y}{7}$ muſt be a whole number. Let us aſſume $\frac{2-4y}{7}=z$, then $x=14-y+z$ and $4y=2-7z$ or $y=\frac{2-7z}{4}=\frac{2-3z}{4}-z$, therefore $\frac{2-3z}{4}$ muſt be a whole number. Aſſume $\frac{2-3z}{4}=t$, then $y=t-z$, and $3z=2-4t$, or $z=\frac{2-4t}{3}=\frac{2-t}{3}-t$, therefor $\frac{2-t}{3}$ muſt be a whole number.

Aſſume now $\frac{2-t}{3}=v$, then $z=v-t$ and $t=2-3v$, here it is evident v may be any whole number taken at pleaſure, ſo that to determine x and y we have the following ſeries of equations:

$$\begin{aligned} t &= 2-3v \\ z &= v-t = 4v-2 \\ y &= t-z = 4-7v \\ x &= 14-y+z = 11v+8. \end{aligned}$$

Now from the value of y it appears, that v muſt either be $=0$, or negative; but from the value of x we find that v cannot be a negative whole number, therefore v can only be $=0$; hence the only values which x and y can have in whole numbers are $x=8$, $y=4$.

Ex. 3. It is required to find all the poſſible ways in which 60l. can be paid in guineas and moidores only.

Let x be the number of guineas and y the number of moidores. Then the value of the guineas, expreſſed in ſhillings, is $21x$, and that of the moidores $27y$, therefore from the nature of the queſtion $21x+27y=1200$, or, dividing the equation by 3, $7x+9y=400$, hence $x=\frac{400-9y}{7}=57-y+\frac{1-2y}{7}$, ſo that $\frac{1-2y}{7}$ muſt be a whole number.

Aſſume $\frac{1-2y}{7}=z$, then $x=57-y+z$ and $2y=1-7z$ or $y=\frac{1-7z}{2}=\frac{1-z}{2}-3z$ therefore $\frac{1-z}{2}$ muſt be a whole number.

Aſſume $\frac{1-z}{2}=v$, then $y=v-3z$ and $z=1-2v$ therefore v may be taken any whole number at pleaſure, and x and y may be determined by the following equations

$$\begin{aligned} z &= 1-2v \\ y &= v-3z = 7v-3 \\ x &= 57-y+z = 61-9v \end{aligned}$$

From the value of x, it appears that v cannot exceed 6, and from the value of y, that it cannot be leſs than 1.

$$\begin{array}{lllllll} \text{Hence if } v= & 1, & 2, & 3, & 4, & 5, & 6, \\ \text{we have } x= & 52, & 43, & 34, & 25, & 16, & 7, \\ \qquad\quad y= & 4, & 11, & 18, & 25, & 32, & 39. \end{array}$$

315. In the foregoing examples the unknown quantities x and y have each a determinate number of poſitive values, and this will evidently be the caſe as often as the propoſed equation is of this form $ax+by=c$. If, however, b be negative, that is, if the equation be of this form $ax-by=c$, or $ax=by+c$, we ſhall have queſtions of a different kind, admitting each of an infinite number of ſolutions, theſe, however, are to be reſolved in the ſame manner as the preceding, as will appear from the following example.

Ex. 4. A perſon buys ſome horſes and oxen, he pays 31 crowns for each horſe, and 20 crowns for each ox, and he finds that the oxen coſt him ſeven crowns more than the horſes. How many did he buy of each?

Let x be the number of horſes, and y that of the oxen, then by the queſtion

$$20x=31y+7, \text{ and } x=\frac{31y+7}{20}=y+\frac{11y+7}{20}.$$

Therefore $\frac{11y+7}{20}$ muſt be a whole number.

Let $\frac{11y+7}{20}=v$, then $x=y+v$ and $y=\frac{20v-7}{11}=v+\frac{9v-7}{11}$; hence $\frac{9v-7}{11}$ muſt be a whole number.

Let $\frac{9v-7}{11}=t$, then $y=v+t$ and $v=\frac{11t+7}{9}=t+\frac{2t+7}{9}$; therefore $\frac{2t+7}{9}$ is a whole number.

Let $\frac{2t+7}{9}=s$, then $v=t+s$ and $t=\frac{9s-7}{2}=4s+\frac{s-7}{2}$; therefore $\frac{s-7}{2}$ is a whole number.

Put $\frac{s-7}{2}=r$, then $t=4s+r$ and $s=2r+7$.

Having now no longer any fractions, we return to the values of x and y by the following ſeries of equations

Indeterminate Problems.

$$\begin{aligned} s&=2r+7\\ t&=4s+r=\ 9r+28\\ v&=\ t+s=11r+35\\ y&=\ v+t=20r+63 = \text{number of oxen,}\\ x&=\ y+v=31r+98 = \text{number of horſes.}\end{aligned}$$

The leaſt poſitive values of x and y will evidently be obtained by making $r=-3$, and innumerable other values will be had by putting $r=-2$, $r=-1$, $r=0$, $r=+1$, &c. Thus we have

$$\begin{array}{l} x=5,\ 36,\ 67,\ 98,\ 129,\ 160,\ 191,\ 222,\ \&c.\\ y=3,\ 23,\ 43,\ 63,\ \ 83,\ 103,\ 123,\ 143,\ \&c.\end{array}$$

each ſeries forming an arithmetical progreſſion, the common difference in the firſt being 31 and in the ſecond 20.

316. If we conſider the manner in which the numbers x, y, in this example, are determined, from the ſucceeding quantities v, t, &c. we ſhall immediately perceive that the coefficients of thoſe quantities are the ſame as the ſucceſſive quotients which ariſe in the arithmetical operation for finding the greateſt common meaſure of 20 and 31, the coefficients of the given equation $20x=31y+7$. The operation performed at length will ſtand thus

```
20)31(1
   20
   --
   11)20(1
      11
      --
       9)11(1
          9
          --
          2)9(4
            8
            --
            1)2(2
              2
              --
              0
```

Hence we may form a ſeries of numeral equations which, when compared with the ſeries of literal equations expreſſing the relations between x, y, v, &c. as put down in the following table, will render the method of determining the latter from the former ſufficiently obvious

$$\begin{array}{rl} 31=1\times 20+11 & x=1\times y+v\\ 20=1\times 11+\ 9 & y=1\times v+t\\ 11=1\times\ 9+\ 2 & v=1\times t+s\\ 9=4\times\ 2+\ 1 & t=4\times s+r\\ 2=2\times\ 2+\ 0 & s=2\times r+7\end{array}$$

And as every queſtion of this kind may be analyzed in the ſame manner, we may hence form the following general rule for reſolving indeterminate problems of the firſt order.

317. Let $bx=ay+n$ be the propoſed equation in which a, b, n, are given integers, and x, y numbers to be found. Let a be the greateſt of the two numbers a, b, and let A denote the greateſt multiple of b which is contained in a, and c; the remainder alſo let B denote the greateſt multiple of c contained in b, and d the remainder; and C the greateſt multiple of d contained in c, and e the remainder; and ſo on, till one of the remainders be found equal to 0. The numbers A, B, C afford a ſeries of equations from which another ſeries may be derived as in the following table.

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$$\begin{array}{ll} a=Ab+c \text{ hence we derive} & x=Ay+v\\ b=Bc+d & y=Bv+t\\ c=Cd+e & v=Ct+s\\ d=De+f & t=Ds+r\\ e=Ef+g & s=Er+q\\ f=Fg+0 & r=Fq\pm n\end{array}$$

and in the laſt equation of the ſecond ſeries any number whatever may be put for q, it is alſo to be obſerved that the given number n is to have the ſign $+$ prefixed to it, if the number of equations be odd, but $-$ if that number be even. Having formed the ſecond ſeries of equations, the values of x and y may be thence found as in the foregoing examples. We proceed to ſhew the application of the rule.

Ex. 5. Required a number which being divided by 11 leaves the remainder 3, but being divided by 19 leaves the remainder 5.

Let N be the number, and x, y the quotients which ariſe from the reſpective diviſions, then we have $N=11x+3$, alſo $N=19y+5$, hence $11x+3=19y+5$ and $11x=19y+2$, an equation which furniſhes the following table.

$$\begin{array}{rl} 19=1\times 11+8 & x=\ y+v\\ 11=1\times\ 8+3 & y=\ v+t\\ 8=2\times\ 3+2 & v=2t+s\\ 3=1\times\ 2+1 & t=\ s+r\\ 2=2\times\ 1+0 & s=2r+2\end{array}$$

Here r may be aſſumed of any value whatever,

Hence we have

$$\begin{aligned} s&=2r+2\\ t&=\ s+r=\ 3r+\ 2\\ v&=2t+s=\ 8r+\ 6\\ y&=\ v+t=11r+\ 8\\ x&=\ y+v=19r+14\end{aligned}$$

and the number required $N=209u+157$ where it is evident that the leaſt number which can expreſs N is 157.

Ex. 6. Given $\left\{\begin{array}{l}3x+\ 5y+\ 7z=560\\ 9x+25y+49z=2920\end{array}\right\}$ To determine x, y, z in whole numbers.

From 7 times the firſt equation ſubtract the ſecond; thus we have $12x+10y=1000$, or $6x+5y=500$ and from this laſt equation by proceeding as in the foregoing examples we find

$$x=500-5v, \qquad y=6v-500.$$

Let theſe values of x and y be ſubſtituted in either of the original equations; in the firſt, for example, as being the moſt ſimple, and we find $7z+15v=1560$. This laſt equation being reſolved in the ſame manner we find

v=

Indeterminate Problems.

$$v=1560-7t$$
$$z=15t-3120$$
$$y=8860-42t$$
$$x=35t-7300$$

and hence it appears that the only values which t can have so as to give whole positive numbers for x, y, z are 209 and 210, thus we have

$$x=15 \quad y=82 \quad z=15$$
$$\text{or } x=50 \quad y=40 \quad z=30.$$

318. If an equation was proposed involving three unknown quantities, as $ax+by+cz=d$, by transposition we have $ax+by=d-cz$ and, putting $d-cz=c'$, $ax+by=c'$. From this last equation we may find values of x and y of this form

$$x=mr+nc', \; y=m'r+n'c'$$
$$\text{or } x=mr+n(d-cz), \; y=m'r+n'(d-cz)$$

where z and r may be taken at pleasure, except in so far as the values of x, y, z may be required to be all positive, for from such restriction the values of z and r may be confined within certain limits to be determined from the given equation.

319. We proceed to indeterminate problems of the second degree. These produce equations of the three following forms,

$$\text{I. } y=\frac{a}{b+cx}, \text{ II. } y=\frac{a+bx}{c+dx}, \text{ III. } y=\sqrt{a+bx+cx^2}.$$

In all these equations a, b, c denote given numbers; in the two first x is to be determined so that y may be an integer, and in the third x is to be determined so that y may be a rational quantity.

320. In the equation $y=\frac{a}{b+cx}$ it is evident $b+cx$ must be a divisor of a, let d be one of its divisors, then $b+cx=d$, and $x=\frac{d-b}{c}$, hence, to find x we must search among the divisors of a for one such that if b be subtracted from it the remainder may be divisible by c, and the quotient will be such a value of x as is required.

321. When $y=\frac{a+bx}{c+dx}$, if d be a divisor of b, x will be taken out of the numerator if we divide it by $c+dx$ and this form is then reduced to the preceding. But if d is not a divisor of b, multiply both sides by d, then $dy=\frac{da+dbx}{c+dx}$ or $dy=b+\frac{ad-bc}{c+dx}$, and so x is found by making $c+dx$ equal to a divisor of $ad-bc$.

Example. Given $x+y+2xy=195$ to determine x and y in whole numbers.

From the given equation $y=\frac{195-x}{1+2x}$, therefore

$$2y=\frac{390-2x}{1+2x}=-1+\frac{391}{1+2x}. \quad \text{Now } 391=17\times 23$$

hence we must assume $1+2x=17$, or $1+2x=23$, the first supposition gives us $x=8$, $y=11$; and the second $x=11$, $y=8$, the same result in effect as the former.

322. It remains to consider the formula $y=\sqrt{a+bx+cx^2}$ where x is to be found so that y may be a rational quantity, but as the condition of having x and y also integers would add greatly to the difficulty of the problem and produce researches of a very intricate nature, we must be satisfied for the most part with fractional values. The possibility of rendering the proposed formula a square depends altogether upon the coefficients a, b, c; and there are four cases of the problem, the solution of each of which is connected with some peculiarity in their nature.

323. *Case* 1. Let a be a square number, then, putting g^2 for a, we have $y=\sqrt{g^2+bx+cx^2}$. Suppose $\sqrt{g^2+bx+cx^2}=g+mx$ then $g^2+bx+cx^2=g^2+2gmx+m^2x^2$, or $bx+cx^2=2gmx+m^2x^2$, that is $b+cx=2gm+m^2x$, hence

$$x=\frac{2gm-b}{c-m^2}, \; y=\sqrt{g^2+bx+cx^2}=\frac{cg-bm+gm^2}{c-m^2}.$$

Here m may be any rational quantity either whole or fractional.

324. *Case* 2. Let c be a square number $=g^2$, then putting $\sqrt{a+bx+g^2x^2}=m+gx$, we find $a+bx+g^2x^2=m^2+2mgx+g^2x^2$, or $a+bx=m^2+2mgx$, hence we find

$$x=\frac{m^2-a}{b-2mg}, \; y=\sqrt{a+bx+g^2x^2}=\frac{bm-gm^2-ag}{b-2mg}.$$

Here m, as before, may be taken at pleasure.

325. *Case* 3. When neither a nor c are square numbers, yet, if the expression $a+bx+cx^2$ can be resolved into two simple factors as $f+gx$ and $h+kx$ the irrationality may be taken away as follows.

Assume $\sqrt{a+bx+cx^2}=\sqrt{(f+gx)(h+kx)}=m(f+gx)$, then $(f+gx)(h+kx)=m^2(f+gx)^2$, or $h+kx=m^2(f+gx)$, hence we find

$$x=\frac{fm^2-h}{k-gm^2}, \; y=\sqrt{(f+gx)(h+kx)}=\frac{(fk-gh)m}{k-gm^2}$$

and in these formulæ m may be taken at pleasure.

326. *Case* 4. The expression $a+bx+cx^2$ may be transformed into a square as often as it can be resolved into two parts, one of which is a complete square, and the other a product of two simple factors; for then it has this form p^2+qr, where p, q, and r are quantities which contain no power of x higher than the first. Let us assume $\sqrt{p^2+qr}=p+mq$; thus we have $p^2+qr=p^2+2mpq+m^2q^2$ and $r=2mp+m^2q$, and as this equation involves only the first power of x we may by proper reduction obtain from it rational values of x and y as in the three foregoing cases.

327. If we can by trials discover any one value of x which renders the expression $\sqrt{a+bx+cx^2}$ rational we may immediately reduce the quantity under the radical sign to the above-mentioned form, and thence find a general expression from which as many more values of x may be determined as we please. Thus let us suppose that p is a value of x which satisfies the condition

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dition required, and that q is the corresponding value of y, then

$$y^2=a+bx+cx^2$$
$$q^2=a+bp+cp^2.$$

Therefore, by subtraction,

$$y^2-q^2=b(x-p)+c(x^2-p^2)=(b+cp+cx)(x-p)$$

and $y=\sqrt{q^2+(b+cp+cx)(x-p)}$. The quantity under the radical sign being now reduced to the prescribed form, it may be rendered rational by the substitution pointed out in last article.

328. The application of the preceding general methods of resolution to any particular case is very easy, we shall therefore conclude with a very few examples.

Ex. 1. It is required to find two square numbers whose sum is a given square number.

Let a^2 be the given square number, and x^2, y^2, the numbers required. Then by the question $x^2+y^2=a^2$, and $y=\sqrt{a^2-x^2}$. This equation is evidently of such a form as to be resolvable by the method employed in case 1. Accordingly by comparing $\sqrt{a^2-x^2}$ with the general expression $\sqrt{g^2+bx+cx^2}$ we have $g=a$, $b=0$, $c=-1$, and substituting these, values in the formulæ of § 323. also $-n$ for $+m$, we find

$$x=\frac{2an}{n^2+1},\ y=\frac{a(n^2-1)}{n^2+1},$$ hence the numbers required are

$$x^2=\frac{4a^2n^2}{(n^2+1)^2} \qquad y^2=\frac{a^2(n^2-1)^2}{(n^2+1)^2}$$

If $a=n^2+1$, where n is any number whatever, the square numbers x^2 and y^2 will both be integers, viz. $x^2=4n^2$ and $y^2=(n^2-1)^2$. Let us suppose $n=2$, then $a=n^2+1=5$, and $a^2=25$, hence $x^2=4n^2=16$, $y=(n^2-1)^2=9$. Thus it appears that the square number 25 may be resolved into two other square numbers 9 and 16.

Ex. 2. It is required to find two square numbers whose difference shall be equal to a given square number b^2.

This question may be resolved in the same manner as the last. Or, without referring to any former investigation, let $(x+n)^2$ and x^2 be the numbers sought, then $(x+n)^2-x^2=b^2$, that is $2nx+n^2=b^2$, hence $x=\frac{b^2-n^2}{2n}$ and $x+n=\frac{b^2+n^2}{2n}$. So that the numbers sought are

$$\frac{(b^2+n^2)^2}{4n^2},\qquad \frac{(b^2-n^2)^2}{4n^2}$$

where n may be any number whatever. If for example $b^2=25$ and $n=1$, then $x=12$ and $x+n=13$; so that the numbers required are 144 and 169.

Ex. 3. It is required to determine x, so that $\frac{x^2+x}{2}$ may be a rational square.

Let y be the side of the square required, then $\frac{x^2+x}{2}=y^2$ and $4x^2+4x=8y^2$. Let the first part of this equation be completed into a square by adding 1 to each side, then $4x^2+4x+1=1+8y^2$, and taking the root $2x+1=\sqrt{1+8y^2}$, so that we have to make $1+8y^2$ a square. Assume

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$1+8y^2=\left(1+\frac{p}{q}y\right)^2=1+\frac{2p}{q}y+\frac{p^2}{q^2}y^2$, then $8y=\frac{2p}{q}+\frac{p^2}{q^2}y$. Hence by proper reduction $y=\frac{2pq}{8q^2-p^2}$ and since $2x+1=\sqrt{1+8y^2}=\frac{8q^2+p^2}{8q^2-p^2}$ therefore $x=\frac{p^2}{8q^2-p^2}$ and $\frac{x^2+x}{2}=\frac{4p^2q^2}{(8q^2+p^2)^2}$, a rational square as was required.

Sect. XXIII. *Of the Resolution of Geometrical Problems.*

329. When a geometrical problem is to be resolved by algebra, the figure which is to be the subject of investigation must be drawn, so as to exhibit as well the known quantities, connected with the problem, as the unknown quantities, which are to be found. The conditions of the problem are next to be attentively considered, and such lines drawn, or produced, as may be judged necessary to its resolution. This done, the known quantities are to be denoted by symbols in the usual manner, and also such unknown quantities as can most easily be determined; which may be either those directly required, or others from which they can be readily found. We must next proceed to deduce from the known geometrical properties of the figure a series of equations, expressing the relations between the known and unknown quantities; these equations must be independent of each other and as many in number as there are unknown quantities. Having obtained a suitable number of equations, the unknown quantities are to be determined in the same manner as in the resolution of numerical problems.

330. No general rule can be given for drawing the lines, and selecting the quantities most proper to be represented by symbols, so as to bring out the simplest conclusion; because different problems require different methods of solution. The best way to gain experience in this matter is to try the solution of the same problem in different ways, and then apply that which succeeds best to other cases of the same kind, when they afterwards occur. The following particular directions however may be of some use.

1. In preparing the figure by drawing lines, let them be either parallel or perpendicular to other lines in the figure, or so as to form similar triangles. And if an angle be given, it will be proper to let the perpendicular be opposite to that angle, and to fall from one end of a given line, if possible.

2. In selecting the quantities for which symbols are to be substituted, those are to be chosen, whether required or not, which lie nearest the known or given parts of the figure, and by means of which the next adjacent parts may be expressed by addition and subtraction only, without the intervention of surds.

3. When two lines, or quantities, are alike related to other parts of the figure, or problem, the best way is to substitute for neither of them separately but to substitute for their sum, or difference, or rectangle, or the sum of their alternate quotients, or some line or lines in the figure, to which they have both the same relation.

4. When

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4. When the area, or the perimeter of a figure is given, or such like parts of it as have only a remote relation to the parts required: it is sometimes of use to assume another figure similar to the proposed one, having one side equal to unity, or some other known quantity. For from hence the other parts of the figure may be found by the known proportions of like sides or parts, and so an equation will be obtained.

331. We shall now give the algebraical solutions of some geometrical problems.

PROB. 1. In a right angled triangle, having given the base, and the sum of the hypothenuse and perpendicular, to find both these two sides.

Let ABC (Plate XIV. fig. 1.) represent the proposed triangle, right angled at B. Let AB, the given base, be denoted by b, and AC+BC the sum of the hypothenuse and perpendicular by s; then if x be put for BC the perpendicular, the hypothenuse AC will be $=s-x$. But from the nature of a right angled triangle $AC^2=AB^2+BC^2$, that is

$$b^2+x^2=(s-x)^2=s^2-2sx+x^2$$

Hence $b^2=s^2-2sx$, and $x=\frac{s^2-b^2}{2s}=BC$. Also $s-x=s-\frac{s^2-b^2}{2s}=\frac{s^2+b^2}{2s}=AC$. Thus the perpendicular and hypothenuse are expressed by means of the known quantities b and s as required.

If a solution in numbers be required, we may suppose $AB=b=3$ and $AC+CB=s=9$, then

$$BC=\frac{s^2-b^2}{2s}=4, \text{ and } AC=\frac{s^2+b^2}{2s}=5.$$

PROB. 2. In a right angled triangle, having given the hypothenuse, also the sum of the base and perpendicular, it is required to determine both these two sides.

Let ABC (fig. 1.) represent the proposed triangle, right angled at B. Put $a=AC$ the given hypothenuse, and $s=AB+BC$ the given sum of the sides, then if x be put for AB, the base, $s-x$ will denote BC the perpendicular.

Now from the nature of right angled triangles $AC^2=AB^2+BC^2$, therefore $x^2+(s-x)^2=a^2$, or $x^2+s^2-2sx+x^2=a^2$, hence we have this quadratic equation $x^2-sx=\frac{a^2-s^2}{2}$, which being resolved, by completing the square, we find $x=\frac{s\pm\sqrt{2a^2-s^2}}{2}=AB$, and $s-x=\frac{s\mp\sqrt{2a^2-s^2}}{2}=BC$. Thus it appears that either of the two quantities $\frac{s+\sqrt{2a^2-s^2}}{2}$, $\frac{s-\sqrt{2a^2-s^2}}{2}$ may be taken for AB, but which ever of the two be taken, the remaining one is necessarily equal to BC.

PROB. 3. It is required to inscribe a square in a given triangle.

Let ABC (fig. 2.) be the given triangle, and EFGH the inscribed square. Draw the perpendicular AD cutting EF the side of the square in K, then, because the triangle is given, the perpendicular AD may be considered as given. Let $BC=b$, $AD=p$, and, considering AK as the unknown quantity, (because from it the square may be readily determined), let $AK=x$; then $KD=EF=p-x$.

The triangles ABC, AEF are similar; therefore AD : BC :: AK : EF; that is $p:b::x:p-x$. Hence by taking the product of the extremes and means, $p^2-px=bx$, and $x=\frac{p^2}{p+b}=AK$. If the side of the square be required, it may be immediately found by subtracting AK from AD the perpendicular. Thus we have $p-\frac{p^2}{p+b}=\frac{pb}{p+b}=KD=EF$. Hence it appears that we may either take AK a third proportional to AD+BC and AD, or take DK a fourth proportional to AD+BC, AD and BC, and the point K being found, the manner of constructing the square is sufficiently obvious.

PROB. 4. Having given the area of a rectangle inscribed in a given triangle, it is required to determine the sides of the rectangle.

Let ABC (fig. 3.) be the given triangle, and EDGF the rectangle whose sides are required. Draw the perpendicular CI cutting DG in H. Put $AB=b$, $CI=p$, $DG=EF=x$, $DE=HI=y$, then $CH=p-y$. Let a^2 denote the given area.

The triangles CDG, CAB are similar, hence

$$CH : DG :: CI : AB, \text{ or } p-y : x :: p : b.$$

So that to determine x and y we have these two equations

$$xy=a^2,\quad bp-by=px.$$

From the first equation we find $y=\frac{a^2}{x}$, and from the second $y=\frac{bp-px}{b}$, therefore $\frac{bp-px}{b}=\frac{a^2}{x}$ hence $x^2-bx=-\frac{a^2b}{p}$, and from this quadratic equation, by completing the square, &c. we find

$$x=\frac{b}{2}\pm\sqrt{\frac{b^2}{4}-\frac{a^2b}{p}}, \text{ and } y=\frac{a^2}{x}=\frac{p}{2}\mp\sqrt{\frac{p^2}{4}-\frac{pa^2}{b}}.$$

Hence it appears that if $\frac{a^2b}{p}$ be less than $\frac{b^2}{4}$, that is if a^2 be less than $\frac{pb}{4}$, there are two different rectangles, having the same area, which may be inscribed in the given triangle. It also appears that to render the problem possible, the given space a^2 must not be greater than $\frac{pb}{4}$, that is, than half the area of the given triangle.

PROB. 5. In a triangle, there are given, the base, the vertical angle, and the sum of the sides about that angle to determine each of these sides.

Let us suppose that ABC (fig. 4.) is the triangle, of which there is given the base AC, the vertical angle ABC

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ABC and the sum of the sides AB, BC. Put $AC=a$, $AB+BC=b$, cosine of $\angle ABC=c$, and let AB, BC, the sides required, be denoted by x and y.

Let CD be drawn from either of the angles at the base perpendicular to the opposite side AB, then, rad. : cos. B :: CB : BD; therefore $BD=\text{cos. } B\times CB=cy$.

Now, from the principles of geometry, $AC^2=AB^2+BC^2-2AB\times BD$. Hence, and from the question, we have these two equations

$$x+y=b,\ x^2-2cxy+y^2=a^2.$$

From the square of the first of these equations, *viz.* $x^2+2xy+y^2=b^2$, let the second be subtracted, thus we have $2(1+c)xy=b^2-a^2$, and $2xy=\frac{b^2-c^2}{1+c}$. Again, from the square of the first equation let the double of this last equation, *viz.* $4xy=\frac{2(b^2-a^2)}{1+c}$, be subtracted, and the result is $x^2-2xy+y^2=\frac{2a^2-(1+c)b^2}{1+c}$, so that by taking the square root of this last equation we obtain

$$x-y=\sqrt{\frac{2a^2-(1+c)b^2}{1+c}}.$$

Thus we have found the difference between the sides, now their sum is given$=b$, hence, by adding $\frac{1}{2}$ the difference to $\frac{1}{2}$ the sum we find

$$x=\frac{b}{2}+\tfrac{1}{2}\sqrt{\frac{2a^2-(1+c)b^2}{1+c}};$$

and subtracting $\frac{1}{2}$ the difference from $\frac{1}{2}$ the sum

$$y=\frac{b}{2}-\tfrac{1}{2}\sqrt{\frac{2a^2-(1+c)b^2}{1+c}}.$$

If the angle at B be a right angle this problem becomes the same as prob. 2.

332. By a method of investigation, in all respects similar to that which has been employed in these examples any proposed geometrical problem may be reduced to an algebraic equation, the roots of which will exhibit arithmetical values of that geometrical magnitude which constitutes the unknown quantity in the equation. But the roots of algebraic equations may also be expressed by geometrical magnitudes, and hence a geometrical construction of a problem may be derived from its algebraic solution. For example, quadratic equations, which all belong to one or other of these three forms,

$$x^2+ax=bc,\ x^2-ax=bc,\ x^2-ax=-bc$$

$$\text{or } x(x+a)=bc,\ x(x-a)=bc,\ x(a-x)=bc$$

may be constructed as follows.

333. *Construction of the first and second forms.* Let a circle EABD (fig. 5.) be described with a radius $=\frac{1}{2}a$, in which, from any point A in the circumference apply a chord $AB=b-c$ (b being supposed greater than c) and produce AB so that $BC=c$; then $AC=a$.

Let H be the centre of the circle, join CH cutting the circumference in D and E, then, in the first case, the positive value of x shall be represented by CD, and in the second by CE. For, by construction $DE=a$, therefore, if CD be called x, then $CE=x+a$, but if CE $=x$, then $CD=x-a$. Now by the elements of geometry $EC\times CD=AC\times CB$, that is $x(x\pm a)=bc$ or $x^2\pm ax=bc$, which equation comprehends the first and second cases.

If the negative roots be required, that of the first case will be CE and that of the second CD.

When b and c are equal the construction will be rather more simple, for then AB vanishing, AC will coincide with the tangent CF. Therefore if a right angled triangle HFC be constructed whose legs HF and FC are equal respectively to $\frac{1}{2}a$ and b, then will CD, the value of x in the first case be equal to CH—HF and CE, the value of x in the latter, $=CH+HF$.

334. *Construction of the third form.*—Let a circle EADB (fig. 6.) be described with a radius $=\frac{1}{2}a$ as before, in which apply a chord $AB=b+c$, and take $AC=b$. Through C draw the diameter DCE, then either DC or EC will be positive roots of the equation. For since $ED=a$, if either EC or $CD=x$, the remaining part of the diameter shall be $a-x$, now by the nature of the circle $EC\times CD=AC\times CB$, that is $x(a-x)=bc$ or $x^2-ax=-bc$, hence it is evident that the roots are rightly determined.

If b and c are equal the construction will be the same, only it will then not be necessary to describe the whole circle; for since AC will be perpendicular to the diameter, if a right angled triangle HCA be constructed, having its hypothenuse $HA=\frac{1}{2}a$ and base $AC=b$, the roots of the equation will be expressed by AH+HC and AH—HC.

335. If b and c be so unequal, that $b-c$ in the first two cases, or $b+c$ in the third, is greater than a, then, instead of these quantities, $\frac{1}{2}b$ and $2c$, or in general $\frac{b}{n}$ and nc (where n is any number whatever) may be used. Or a mean proportional may be found between b and c, and the construction performed as directed in each case when b and c are equal.

336. It appears from § 333 and 334, that every geometrical problem which produces a quadratic equation may be constructed by means of a straight line and a circle, or is a *plane* problem, hence on the contrary, if a problem can be constructed by straight lines and circles, its algebraic resolution will not produce an equation higher than a quadratic. Cubic and biquadratic equations may be constructed geometrically by means of any two conic sections, hence it follows that every geometrical problem which requires for its construction two conic sections, will, when resolved by algebra, produce a cubic or biquadratic equation.

Sect. XXIV. *Of the Loci of Equations.*

Loci of Equations.

337. When an equation contains two indeterminate quantities x and y, then for each particular value of x there may be as many values of y as it has dimensions in that equation. So that if in an indefinite line AE (fig. 7.) there be taken a part AP to represent x, and a perpendicular PM be drawn to represent y, there will be as many points M, M′, &c. the extremities of these perpendiculars, as there are dimensions of y in the proposed equation. And the values of PM, PM′, &c. will be the roots of the equation which are found by substituting for x its value in any particular case.

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case. Hence it appears that in any particular equation we may determine as many points M, as we please, and a line which passes through all these points is called the *locus* of the equation. The line AP which expresses any value of x is called an *abscis*; and PM which expresses the corresponding value of y is called an *ordinate*. Any two corresponding values of x and y are also called *co-ordinates*.

338. When the equation that arises by substituting for x any particular value AP has all its roots positive, the points M, M′, &c. will lie all on one side of AE, but if any of them be negative, these must be set off on the other side of AE towards m.

If x be supposed to become negative, then the line Ap which represents it is to be taken in a direction the opposite to that which represents the positive values of x; the points M, m, are to be taken as before, and the *locus* is only complete when it passes through all the points M, m, so as to exhibit a value of y corresponding to every possible value of x.

If in any case one of the values of y vanish, then the point M coincides with P, and the *locus* meets AE in that point. If one of the values of y become infinite, then it shews that the curve has an infinite arc, and in that case the line PM becomes an *asymptote* to the curve, or touches it at an infinite distance, if AP itself is finite.

If when x is supposed infinitely great, a value of y vanish, then the curve approaches to AE as an asymptote.

If any values of y become impossible, then so many points M vanish.

339. From these observations and the theory of equations, it appears that when an equation is proposed involving two indeterminate quantities x and y, there may be as many intersections of the curve that is the *locus* of the equation and of the line PM, as there are dimensions of y in the equation; and as many intersections of the curve and the line AE as there are dimensions of x in the equation.

340. A curve line is called *geometrical* or *algebraic*, when the equation which expresses the relation between x and y, any abscis and its corresponding ordinate, consists of a finite number of terms, and contains besides these quantities only known quantities. Algebraic curves are divided into *orders* according to the dimensions of the equations which expresses the relations between their abscisses and ordinates, or according to the number of points in which they can intersect a straight line.

341. *Straight lines* themselves constitute the first order of lines, and when the equation expressing the relation between x and y is only of one dimension, the points M must be all found in a straight line which contains with AE a given angle. Suppose for example that the given equation is $ay-bx-cd=0$, and that its *locus* is required.

Since $y=\frac{bx+cd}{a}$, it follows that APM (fig. 8.) being a right angle, if AN be drawn making the angle NAP such that its cosine is to its sine as a to b, and drawing AD parallel to the ordinates PM, and equal to $\frac{cd}{a}$, if DF be drawn parallel to AN, then will DF be the *locus* required; where it is to be observed that AD and PN are to be taken on the same side of AE if bx and cd have the same sign, but on opposite sides of AE if they have contrary signs.

342. These curves whose equations are of two dimensions constitute the *second* order of lines, and the *first* kind of curves. Their intersections with a straight line can never exceed two (§ 339.)

The curves whose equations are of three dimensions form the *third* order of lines, and the *second* kind of curves; and their intersections with a straight line can never exceed three, and after the same manner curves of the higher orders are denominated.

Some curves, if they were completely described, would cut a straight line in an infinite number of points, but these belong to none of the orders we have mentioned, for the relation between their ordinates and abscisses cannot be expressed by a finite equation, involving only ordinates and abscisses with determinate quantities. Curves of this kind are called *mechanical* or *transcendental*.

343. As the roots of an equation become impossible always in pairs, so the intersections of a curve and its ordinate PM must vanish in pairs if any of them vanish. Let PM (fig. 9.) cut the curve in the points M and m, and by moving parallel to itself come to touch it in the point N, then the two points of intersection M and m go to form one point of contact N. If PM still move on parallel to itself, the points of intersection will beyond N become imaginary, as the two roots of an equation first become equal, and then imaginary.

344. The curves of the 3d, 5th, 7th orders, and all whose dimensions are odd numbers, have always one real root at least, and consequently for every value of x the equation by which y is determined must have at least one real root; so that as x, or AP may be increased *in infinitum* on both sides, it follows that M must go off *in infinitum* on both sides without limit.

In curves whose dimensions are even numbers, as the roots of their equations may become all impossible, it follows that the figure of the curve may be like a circle or oval that is limited within certain bounds, beyond which it cannot extend.

345. When two roots of the equation by which y is determined become equal, either the ordinate PM touches the curve, two points of intersection in that case going into a point of contact, or the point M is a *punctum duplex* in the curve, two of its arcs intersecting each other there; or some oval that belongs to that kind of curve becoming infinitely little in M, it vanishes into what is called a *punctum conjugatum*.

If in the equation y be supposed $=0$, then the roots of the equation by which x is determined, will give the distances of the points where the curve meets AE from A, and if two of those roots be found equal, then either the curve touches the line AE, or AE passes through a *punctum duplex* in the curve. When y is supposed $=0$, if one of the values of x vanish, the curve in that case passes through A. If two vanish, then either AE touches the curve in A, or A is a *punctum duplex*.

As a *punctum duplex* is determined from the equality of two roots, so is a *punctum triplex* from the equality of three roots.

346. To

Loci of Equations.

346. To illustrate these observations we shall take a few examples.

Ex. 1. It is required to describe the line that is the *locus* of this equation $y^2=ax+ab$, or $y^2-ax-ab=0$, where a and b denote given quantities. Since $y^2=\pm\sqrt{ax+ab}$, if AP$=x$ (fig. 10.) be assumed of a known value and PM, Pm set off on each side equal to $\sqrt{ax+ab}$ the points M, m, will belong to the locus required; and for every positive value of AP there may thus be found a point of the locus on each side. The greater AP, or x, is taken, the greater does $\sqrt{ax+ab}$ become, and consequently PM and Pm the greater, and if AP be supposed infinitely great, PM and Pm will also become infinitely great, therefore the locus has two infinite arcs that go off to an infinite distance from AE and from AD. If x be supposed to vanish, then $y=\pm\sqrt{ab}$, so that y does not vanish in that case, but passes through D and d, taking AD and Ad each $=\sqrt{ab}$.

If P be supposed to move to the other side of A, then x becomes negative, and $y=\pm\sqrt{ab-ax}$, so that y will have two values as before, while x is less than b; but if AB$=b$, and the point P be supposed to come to B, then $ab=ax$, and $y=\pm\sqrt{ab-ax}=0$; that is PM and Pm vanish, and the curve there meets the line AE. If P be supposed to move from A beyond B, then x becomes greater than b, and ax greater than ab, so that $ab-ax$ being negative, $\sqrt{ab-ax}$ becomes imaginary; that is, beyond B there are no ordinates which meet the curve, and consequently on that side the curve is limited in B.

All this agrees very well with what is known by other methods, that the curve whose equation is $y^2=ax+ab$ is a parabola whose vertex is B, axis BE, and parameter equal to a. For since $b\pm x=$BP and $y=$PM, from the equation $ab\pm ax=y^2$, or $a(b\pm x)=y^2$, we have $a\times$BP$=$PM^2, which is the well known property of the parabola.

Ex. 2. It is required to describe the line that is the *locus* of the equation $xy+ay+cy=bc+bx$,

$$\text{or } y=\frac{bc+bx}{a+c+x}.$$

Here it is evident (fig. 11.) that the ordinate PM can meet the curve in one point only, there being but one value of y corresponding to each value of x. When $x=0$, then $y=\frac{bc}{a+c}$ so that the curve does not pass through A. If x be supposed to increase, then y will increase, but will never become equal to b, since $y=b\times\frac{c+x}{a+c+x}$, and $a+c+x$ is always greater than $c+x$. If x be supposed infinite, then the terms a and c vanish compared with x, and consequently $y=b\times\frac{x}{x}=b$; from which it appears, that taking AD$=b$, and drawing GD parallel to AE, it will be an *asymptote*, and touch the curve at an infinite distance. If x be now supposed negative, and AP be taken on the other side of A, then $y=b\times\frac{c-x}{a+c-x}$, and if x be taken on that side $=c$, then $y=b\times\frac{c-c}{a}=0$, so that the curve must pass through B if AB$=c$. If x be supposed greater than c, then will $c-x$ become negative, and the ordinate will become negative, and lie on the other side of AE, till x become equal to $a+c$, and then $y=b\times\frac{-a}{0}$, that is, because the denominator is 0, x becomes *infinite*, so that if A be taken$=a+c$, the ordinate KD will be an assymptote to the curve.

If x be taken greater than $a+c$ or AP greater than AK, then both $c-x$ and $a+c-x$ become negative, and consequently $y=b\times\frac{x-c}{x-a-c}$ becomes a positive quantity; and since $x-c$ is always greater than $x-a-c$, it follows that y will be always greater than b or KG, and consequently the rest of the curve lies in the angle FGH. And as x increases, since the ratio of $x-c$ to $x-a-c$ approaches still nearer to a ratio of equality, it follows that PM approaches to an equality with PN, therefore the curve approaches to its asymptote GH on that side also.

This curve is the common hyperbola, for since $b(c+x)=y(a+c+x)$, by adding ab to both sides, $b(a+c+x)=y(a+c+x)+ab$, and $(b-y)(a+c+x)=ab$, that is NM$\times$GN$=$GC$\times$BC which is the property of the common hyperbola.

Ex. 3. It is required to describe the *locus* of the equation $ay^2-xy^2=x^3+bx^2$.

Here $y^2=\frac{x^3+bx^2}{a-x}$, and therefore $y=\pm\sqrt{\frac{x^3+bx^2}{a-x}}$, hence PM and PM (fig. 12.) are to be taken on each side, and equal to $\sqrt{\frac{x^3+bx^2}{a-x}}$; this expression by supposing $x=a$ becomes infinite because its denominator is then $=0$, therefore if AB be taken $=a$ and BK be drawn perpendicular to AB, the line BK shall be an asymptote to the curve. If x be supposed greater than a, or AP greater than AB, then $a-x$ being negative, the fraction $\frac{x^3+bx^2}{a-x}$ will become negative, and its square root impossible; so that no part of the locus can lie beyond B. If x be supposed negative, or P taken on the other side of A, then $y=\pm\sqrt{\frac{-x^3+bx^2}{c+x}}$, hence the values of y will be real and equal as long as x is less than b, but if $x=b$, then $y=\sqrt{\frac{-x^3+bx^2}{a-x}}=\sqrt{\frac{-b^3+b^3}{a-b}}=0$, and consequently if AD be taken $=b$, the curve will pass through D, and there touch the

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the ordinate. If x be taken greater than b, then $\pm\sqrt{\frac{-x^3-ax^2}{c+x}}$ becomes imaginary, so that no part of the curve is found beyond D. The portion between A and D is called a *nodus*. If y be supposed $=0$, then will $x^3+bx^2=0$ be an equation whose roots are $-b, 0, 0$, from which it appears that the curve passes twice through A, and has in A a *punctum duplex*. This locus is a line of the 3d order.

If b is supposed to vanish in the proposed equation, so that $ay^2-xy^2=x^3$, then will A and D coincide (fig. 13.) and the *nodus* vanish, and the curve will have in the point A a *cuspis*, the two arcs AM and Am, in this case, touching one another in that point. This is the same curve which the ancients called the *Cissoid of Diocles*.

If instead of supposing b positive, or equal to 0, we suppose it negative, the equation will be $ay^2-xy^2=x^3-bx^2$, the curve will in this case pass through D as before, (fig. 14.) and taking AB$=a$, BK will be its asymptote. It will have a *punctum conjugatum* in A, because when y vanishes two values of x vanish, and the third becomes $=b$ or AD. The whole curve, besides this point, lies between DQ and BK. These remarks are demonstrated after the same manner as in the first case.

347. If an equation have this form

$$y=ax^n+bx^{n-1}+cx^{n-2}+, \&c.$$

and n is an even number, then will the *locus* of the equation have two infinite arcs lying on the same side of AE, (fig. 15.) for if x become infinite, whether positive or negative, x^n will be positive and ax^n have the same sign in either case, and as ax^n becomes infinitely greater than the other terms bx^{n-1}, &c. it follows that the infinite values of y will have the same sign in these cases, and consequently the two infinite arcs of the curve will lie on the same side of AE.

But if n be an odd number, then when x is negative x^n will be negative, and ax^n will have the contrary sign to what it had when x is positive, and therefore the two infinite arcs will in this case lie on different sides of AE, as in fig. 16. and tend towards parts directly opposite.

348. If an equation have this form $yx^n=a^{n+1}$, and n be an odd number, then when x is positive $y=\frac{a^{n+1}}{x^n}$, but when x is negative $y=-\frac{a^{n+1}}{x^n}$, so that this curve must all lie in the vertically opposite angles KAE, FAe, (fig. 17.) as the common hyperbola, FK, Ee being asymptotes.

But if n be an even number then y is always positive whether x be positive or negative, because x^n in this case is always positive, and therefore the curve must all lie in the two adjacent angles KAE and KAe (fig. 18.) and have AK and AE for its asymptotes.

349. If an equation be such as can be reduced into two other equations of lower dimensions, without affecting y or x with any radical sign, then the *locus* shall consist of the two *loci* of those inferior equations. Thus the locus of the equation $y^2-2xy+by+x^2-bx=0$, which may be resolved into these two, $x-y=0$, $y-x+b=0$, is found to be two straight lines cutting the abciss AE (fig. 19.) in angles of 45° in the points A, B, whose distance AB$=b$. In like manner some cubic equations can be resolved into three simple equations, and then the *locus* is three straight lines, or may be resolved into a quadratic and simple equation, and then the locus is a straight line and a conic section. In general, curves of the superior orders include all the curves of the inferior orders, and what is demonstrated generally of any one order is also true of the inferior orders. Thus, for example, any general property of the conic sections holds true of two straight lines as well as a conic section, particularly that the rectangles of the segments of parallels bounded by them will always be to one another in a given ratio.

Arithmetic of Sines.

350. From the analogy which subsists between algebraic equations and geometrical curves it is easy to see that the properties of the former must suggest corresponding properties of the latter. Hence the principles of algebra admit of the most extensive application to the theory of curve lines. It may be demonstrated, for example, that the *locus* of every equation of the second order is a conic section; and, on the contrary, the various properties of the diameters, ordinates, tangents, &c. of the conic sections may be readily deduced from the theory of equations.

Sect. XXV. *Of the Arithmetic of Sines.*

351. The relations which subsist between the sines and cosines of any arches of a circle, and those of their sums, or differences, &c. constitute what is called the *arithmetic of sines*. This branch of calculation has its origin in the application of algebra to geometry, and is of great importance in the more difficult parts of the mathematics, as well as in their application to physics.

352. In treating this subject it is necessary to attend to the following observations.

1. If the sines of all arches between 0° and 180° be supposed positive, the sines of arches between 180° and 360° must be considered as negative; again, the sines of arches between 360° and 540° will be positive, and those of arches between 540° and 720° negative, and so on.

2. If the cosines of arches between 0° and 90° be supposed positive, the cosines of arches between 90° and 270° must be considered as negative, and the cosines of arches between 270° and 450° positive, and so on.

3. When an arch changes from + to —, or from — to + its sine undergoes a like change, but its cosine is the same as before.

The truth of these observations must be evident from this consideration, that when a line, taken in a certain direction, decreases till it become $=0$, and afterwards increases, but in a contrary direction; then, if in the former state it was considered as positive, it must be negative in the latter, and contrariwise.

353. The following proposition may be considered as the foundation of the arithmetic of sines.

Let a and b denote any two arches of a circle.

Then, if radius be supposed $=1$.

$$\text{sin.}\,(a+b) = \text{sin.}\,a \times \text{cos.}\,b + \text{cos.}\,a \times \text{sin.}\,b.$$

Let

Let C be the centre of the circle, (fig. 20.) and AB, BD the arches denoted by a and b; then AD $=a+b$: draw the radii CA, CB, CD, and the ſines BE, BF, DG; then BE, BF, DG are the ſines of a, b, and $a+b$, reſpectively; and CE, CF, CG their coſines. Join EF, and draw FH parallel to DG. Becauſe the angles CEB, CFB are right angles, the points C, E, B, F are in the circumference of a circle, hence, the angle FCB is equal to FEB; that is, to the alternate angle EFH; now CFB, EHF are both right angles, therefore the triangles CFB, EHF are ſimilar, hence CF : CB (=CD) : : FH : FE; but CF : CD : : FH : DG; therefore FH : FE : : FH : DG, hence FE=DG=ſin. $(a+b)$. Becauſe EBFC is a quadrilateral inſcribed in a circle, from the elements of geometry, we have BC × EF = BE × CF + BF × CE but BE = ſin. a, CF = coſ. b, BF = ſin. b, CE = coſ. a, BC=1, and EF=DG=ſin. $(a+b)$, therefore ſin. $(a+b)$=ſin. $a \times$ coſ. $b +$ coſ. $a \times$ ſin. b, as was to be proved.

354. If in the preceding theorem we ſuppoſe the arch b to become negative, then ſin. b will alſo become negative. Thus we obtain a ſecond theorem, viz.

$$\text{Sin. } (a-b) = \text{ſin. } a \times \text{coſ. } b - \text{coſ. } a \times \text{ſin. } b.$$

Becauſe coſ. $(a+b)$ = ſin. $((90°-a)-b)$, and by the ſecond theorem ſin. $((90°-a)-b)$ = ſin. $(90°-a) \times$ coſ. b − coſ. $(90°-a) \times$ ſin. b = coſ. $a \times$ coſ. b − ſin. $a \times$ ſin. b, therefore

$$\text{coſ. } (a+b) = \text{coſ. } a \times \text{coſ. } b - \text{ſin. } a \times \text{ſin. } b$$

which is the third theorem.

If we now ſuppoſe b to become negative, then ſin. b becomes alſo negative; thus we have

Theor. IV. $\text{Coſ. } (a-b) = \text{coſ. } a \times \text{coſ. } b + \text{ſin. } a \times \text{ſin. } b.$

355. We have found that ſin. $(a+b)$ = ſin. $a \times$ coſ. b + coſ. $a \times$ ſin. b; alſo, that ſin. $(a-b)$ = ſin. $a \times$ coſ. b − coſ. $a \times$ ſin. b, therefore, taking the ſum of theſe two equations, we find,

Theor. V. $\text{Sin. } (a+b) + \text{ſin. } (a-b) = 2 \text{ ſin. } a \times \text{coſ. } b.$

In like manner, by taking the difference between the equations, we have

Theor. VI. $\text{Sin. } (a+b) - \text{ſin. } (a-b) = 2 \text{ coſ. } a \times \text{ſin. } b.$

And, by taking the ſum and difference of the equations, which conſtitute the third and fourth theorems, we alſo have

Theor. VII. $\text{Coſ. } (a-b) + \text{coſ. } (a+b) = 2 \text{ coſ. } a \times \text{coſ. } b.$
Theor. VIII. $\text{Coſ. } (a-b) - \text{coſ. } (a+b) = 2 \text{ ſin. } a \times \text{ſin. } b.$

If in the four laſt theorems we ſubſtitute na for a, and a for b, we derive from them theſe other four:

Theor. IX. $2 \text{ Coſ. } a \times \text{ſin. } na = \text{ſin. } (n+1)\,a + \text{ſin. } (n-1)\,a$
Theor. X. $2 \text{ Sin. } a \times \text{coſ. } na = \text{ſin. } (n+1)\,a - \text{ſin. } (n-1)\,a$
Theor. XI. $2 \text{ Coſ. } a \times \text{coſ. } na = \text{coſ. } (n+1)\,a + \text{coſ. } (n-1)\,a$
Theor. XII. $2 \text{ Sin. } a \times \text{ſin. } na = -\text{coſ. } (n+1)\,a + \text{coſ. } (n-1)\,a.$

356. By means of the four laſt theorems, the powers and products of the ſines and coſines of arches may be expreſſed in terms of the ſums and differences of certain multiples of thoſe arches.

Thus, if in theor. XII. we ſuppoſe $n=1$, it becomes

$$2 \text{ Sin.}^2 a = -\text{coſ. } 2a + 1.$$

To find the third power of ſin. a, let both ſides of this equation be multiplied by 2 ſin. a, then 4 ſin.$^3 a$ = 2 ſin. a (− coſ. $2a$ + 1), but 2 ſin. $a \times$ coſ. $2a$ = ſin. $3a$ − ſin. a, theor. X. Therefore

$$4 \text{ Sin}^3 a = -\text{ſin } 3a + 3 \text{ ſin. } a.$$

Again, for the fourth power, let both ſides of the laſt equation be multiplied by 2 ſin. a, then 8 ſin.$^4 a$ = 2 ſin. a (− ſin. $3a$ + 3 ſin. a); but 2 ſin. $a \times$ ſin. $3a$ = − coſ. $4a$ + coſ. $2a$, and 2 ſin. $a \times$ ſin. a = − coſ. $2a$ + 1, theor. XII. therefore by ſubſtitution

$$8 \text{ Sin.}^4 a = \text{coſ. } 4a - 4 \text{ coſ. } 2a + 3.$$

Proceeding in this way the ſucceſſive powers of ſin. a may be calculated as in the following table:

$$\begin{aligned}
\text{Sin. } a &= \text{ſin. } a \\
2 \text{ Sin.}^2 a &= -\text{coſ. } 2a + 1 \\
4 \text{ Sin.}^3 a &= -\text{ſin. } 3a + 3 \text{ ſin. } a \\
8 \text{ Sin.}^4 a &= \text{coſ } 4a - 4 \text{ coſ. } 2a + 3 \\
16 \text{ Sin.}^5 a &= \text{ſin. } 5a - 5 \text{ ſin. } 3a + 10 \text{ ſin. } a \\
32 \text{ Sin.}^6 a &= -\text{coſ. } 6a + 6 \text{ coſ. } 4a - 15 \text{ coſ. } 2a + 10 \\
64 \text{ Sin.}^7 a &= -\text{ſin. } 7a + 7 \text{ ſin. } 5a - 21 \text{ ſin. } 3a + 35. \text{ſin. } a,
\end{aligned}$$
&c.

The

The ſucceſſive powers of the coſines may be found in the ſame manner. Thus

$$\begin{aligned}
\text{Coſ. } a &= \text{coſ. } a \\
2\,\text{Coſ.}^2 a &= \text{coſ. } 2a + 1 \\
4\,\text{Coſ.}^3 a &= \text{coſ. } 3a + 3\,\text{coſ. } a \\
8\,\text{Coſ.}^4 a &= \text{coſ. } 4a + 4\,\text{coſ. } 2a + 3 \\
16\,\text{Coſ.}^5 a &= \text{coſ. } 5a + 5\,\text{coſ. } 3a + 10\,\text{coſ. } a \\
32\,\text{Coſ.}^6 a &= \text{coſ. } 6a + 6\,\text{coſ. } 4a + 15\,\text{coſ. } 2a + 10 \\
64\,\text{Coſ.}^7 a &= \text{coſ. } 7a + 7\,\text{coſ. } 5a + 21\,\text{coſ. } 3a + 35\,\text{coſ. } a, \\
&\text{\&c.}
\end{aligned}$$

357. As an example of the products of the ſines and coſines of an arch, let it be propoſed to expreſs $\text{ſin.}^3 a \times \text{coſ.}^2 a$ by the ſines, or coſines of multiples of a. We have already found $4\,\text{ſin.}^3 a = -3\,\text{ſin. } 3a + 3\,\text{ſin. } a$, therefore

$$16\,\text{ſin.}^3 a \times \text{coſ.}^2 a \begin{cases} = 2\,\text{coſ. } a \times 2\,\text{coſ. } a(-3\,\text{ſin. } 3a + 3\,\text{ſin. } a) \\ = 2\,\text{coſ. } a(-\text{ſin. } 4a + 2\,\text{ſin. } 2a) \\ = -\text{ſin. } 5a + \text{ſin. } 3a + 2\,\text{ſin. } a. \end{cases}$$

Thus it appears that all poſitive integer powers of the ſine and coſine of an arch, or any product of thoſe powers, may be expreſſed in finite terms by the ſines and coſines of multiples of that arch.

358. On the contrary, the ſine and coſine of any arch may be expreſſed by the powers of the ſine and coſine of an arch whereof it is a multiple. For it appears from the 9th and 11th theorems that

$$\begin{aligned}
\text{Sin. } (n+1)a &= 2\,\text{coſ. } a \times \text{ſin. } na - \text{ſin. } (n-1)a \\
\text{Coſ. } (n+1)a &= 2\,\text{coſ. } a \times \text{coſ. } na - \text{coſ. } (n-1)a.
\end{aligned}$$

therefore, by taking $n = 0, 1, 2, 3$, &c. ſucceſſively we have

$$\begin{aligned}
\text{Sin. } a &= \text{ſin. } a \\
\text{Sin. } 2a &= 2\,\text{coſ. } a \times \text{ſin. } a \\
\text{Sin. } 3a &= 2\,\text{coſ. } a \times \text{ſin. } 2a - \text{ſin. } a \\
\text{Sin. } 4a &= 2\,\text{coſ. } a \times \text{ſin. } 3a - \text{ſin. } 2a \\
\text{Sin. } 5a &= 2\,\text{coſ. } a \times \text{ſin. } 4a - \text{ſin. } 3a, \\
&\text{\&c.}
\end{aligned}$$

$$\begin{aligned}
\text{Coſ. } a &= \text{coſ. } a \\
\text{Coſ. } 2a &= 2\,\text{coſ. } a \times \text{coſ. } a - 1. \\
\text{Coſ. } 3a &= 2\,\text{coſ. } a \times \text{coſ. } 2a - \text{coſ. } a \\
\text{Coſ. } 4a &= 2\,\text{coſ. } a \times \text{coſ. } 3a - \text{coſ. } 2a \\
\text{Coſ. } 5a &= 2\,\text{coſ. } a \times \text{coſ. } 4a - \text{coſ. } 3a, \\
&\text{\&c.}
\end{aligned}$$

So that, putting s for the ſine, and c for the coſine of the arch a, and remarking that $c^2 = 1 - s^2$.

$$\begin{aligned}
\text{Sin. } a &= s \\
\text{Sin. } 2a &= 2cs \\
\text{Sin. } 3a &= 4c^2 s - s = -4s^3 + 3s \\
\text{Sin. } 4a &= 8c^3 s - 4cs = c(-8s^3 + 4s) \\
\text{Sin. } 5a &= 16c^4 s - 12c^2 s + s = 16s^5 - 20s^3 + 5s, \\
&\text{\&c.}
\end{aligned}$$

$$\begin{aligned}
\text{Coſ. } a &= c \\
\text{Coſ. } 2a &= 2c^2 - 1 \\
\text{Coſ. } 3a &= 4c^3 - 3c \\
\text{Coſ. } 4a &= 8c^4 - 8c^2 + 1 \\
\text{Coſ. } 5a &= 16c^5 - 20c^3 + 5c, \\
&\text{\&c.}
\end{aligned}$$

359. If it be required to find the ſine or coſine of an arch, from having given the ſine or coſine of ſome multiple of that arch, it may be found by reſolving an equation of an order denoted by the numerical coefficient of the multiple arch. Thus if the coſine of an arch be given, to determine the coſine of half the arch, let C denote the given coſine, and x that which is required, then the equation $\text{coſ. } 2a = 2c^2 - 1$ becomes $C = 2x^2 - 1$, which equation being reſolved gives $x = \pm\sqrt{\frac{1+C}{2}}$. If the ſine be required, from that of twice the arch being given, it may be found from the equation $\text{ſin. } 2a = 2cs$, which, by putting S for the given ſine, and y for the ſine required, becomes $S = 2y\sqrt{1-y^2}$, or, by ſquaring both ſides, and reducing, $y^4 - y^2 = -\frac{S^2}{4}$; whence $y^2 = \frac{1 \pm \sqrt{1-S^2}}{2}$ and $y = \pm\sqrt{\frac{1 \pm \sqrt{1-S^2}}{2}}$.

The two values of x indicate that there are two arches, the one as much leſs than 90°, as the other exceeds 90°, ſuch, that the coſine of the double of each is expreſſed by the ſame number. And the four values of y ſhew that there are four arches, viz. two poſitive and two negative, ſuch, that the ſine of the double of each is expreſſed by the ſame number.

Suppoſe now that the coſine of an arch is given to find the coſine of one-third of that arch, then, putting C to denote the given coſine, and x that which is required, the equation to be reſolved is

$$4x^3 - 3x = C, \text{ or } x^3 - \tfrac{3}{4}x - \frac{C}{4} = 0.$$

By comparing this cubic equation with the general equation $x^3 + qx + r = 0$, it appears that q is negative and ſuch that $4q^3 > 27r^2$, for C is always leſs than unity; hence it follows that the equation belongs to the *irreducible* caſe, or that which cannot be reſolved by Cardan's rule. The equation $4\,\text{ſin.}^3 - 3\,\text{ſin. } a = -\text{ſin. } 3a$ is alſo of the ſame form; in order, therefore, to find either the ſine or coſine of one-third of a given arch recourſe muſt be had to the methods of approximation explained in Sect. XVI.

360. The ſum of any powers of the ſines, or coſines of arches which conſtitute the arithmetical progreſſion a, $a+p$, $a+2p$, $a+3p$, &c. to $a+np$ may be

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be found as follows. We have already found, theor. V. that

$$\text{Sin.}\ (p+d)=2\ \text{cos}.\ d\times\text{sin}.\ p-\text{sin}.\ (p-d)$$

therefore, by substituting a, $a+d$, $a+2d$, &c. successively for p we obtain the following series of equations.

$$\begin{aligned}
\text{Sin.}\ a &= \text{sin}.\ a\\
\text{Sin.}\ (a+d) &= 2\ \text{cos}.\ d\times\text{sin}.\ a-\text{sin}.\ (a-d)\\
\text{Sin.}\ (a+2d) &= 2\ \text{cos}.\ d\times\text{sin}.\ (a+d)-\text{sin}.\ a\\
\text{Sin.}\ (a+3d) &= 2\ \text{cos}.\ d\times\text{sin}.\ (a+2d)-\text{sin}.\ (a+d),\\
&\text{\&c.}\\
\text{Sin.}\ (a+nd) &= 2\ \text{cos}.\ d\times\text{sin}.\ (a+(n-1)d)-\text{sin}.\ (a+(n-2)d)\\
\text{Sin.}\ (a+(n+1)d) &= 2\ \text{cos}.\ d\times\text{sin}.\ (a+nd)-\text{sin}.\ (a+(n-1)d)
\end{aligned}$$

Therefore, if we substitute

$$S=\text{sin}.\ a+\text{sin}.\ (a+d)+\text{sin}.\ (a+2d),\ \text{\&c.}\ +\text{sin}.\ (a+nd),$$

by taking the sum of all the equations, it is evident that

$$S+\text{sin}.\ (a+(n+1)d)=\text{sin}.\ a+2\ \text{cos}.\ d\times S-\text{sin}.\ (a-d)-(S-\text{sin}.\ (a+nd))$$

which equation, by proper reduction becomes

$$S=\frac{\text{sin}.\ a-\text{sin}.\ (a+(n+1)d)+\text{sin}.\ (a+nd)-\text{sin}.\ (a-d)}{2(1-\text{cos}.\ d)}$$

By proceeding in the same manner with theor. VII. viz.

$$\text{Cos.}\ (p+d)=2\ \text{cos}.\ d\times\text{cos}.\ p-\text{cos}.\ (p-d)$$

and substituting a, $a+d$, $a+2d$, &c. successively for p, also putting

$$C=\text{cos}.\ a+\text{cos}.\ (a+d)+\text{cos}.\ (a+2d)+,\ \text{\&c.}\ +\text{cos}.\ (a+nd)$$

we obtain this other theorem

$$C=\frac{\text{cos}.\ a-\text{cos}.\ (a+(n+1)d)+\text{cos}.(a+nd)-\text{cos}.\ (a-d)}{2(1-\text{cos}.\ d)}$$

361. It is worthy of remark, that if the arch d is contained $n+1$ times, either in the whole circumference, or any number of circumferences, that is, if $(n+1)d=q\times 360°$, where q is any whole number, then $nd=q\times 360°-d$. Thus we have sin. $(a+(n+1)d)$ $=$ sin. $(a+q\times 360°)=$ sin. a, also sin. $(a+nd)=$ sin. $(a-d+q\times 360°)=$sin.$(a-d)$, for the sine of any arch is equal to the sine of the same arch increased by any number of circumferences, and the same is true also of the cosine of an arch. Hence it appears that in these circumstances the terms in the numerators of the fractions, which are equal to S and C, destroy one another, and thus S and C are both $=0$; that is, the positive sines, and cosines are equal to the negative sines, and cosines, respectively. Now if the circumference of a circle be divided into $n+1$ equal parts at the points A, A′, A″, A‴, &c. (fig. 21.) and any diameter BC drawn, then, if the arch BA$=a$, and the arch AA′$=d$, the arches BAA′, BAA′A″, &c. will be equal to $a+d$, $a+2d$, &c. respectively; and, supposing the extremity of the diameter to fall between A and A$^{\text{iv}}$, the arch BA, &c. A$^{\text{iv}}$ will be equal to $a+nd$. Hence we derive the following remarkable property of the circle. Let the circumference of a circle be divided into any number of equal parts at the points A, A′, A″, &c.; and from the points of division let the sines AD, A′D′, A″ D″, &c. be drawn upon any diameter BCE; then, the sum of AD, A′D′, &c. the sines on one side of the diameter shall be equal to the sum of A″ D″, A‴ D‴, &c. the sines on the other side of the diameter. Also, the sum of CD, C$^{\text{iv}}$ D$^{\text{iv}}$, the cosines on one side of the centre shall be equal to the sum of C′ D′, C″ D″, &c. the cosines on the other side of the centre.

362. Let us next investigate the sum of the squares of the sines of the arches a, $a+d$, $a+2d$, &c. For this purpose we may form a series of equations from the theorem

$$2\ \text{sin}.^2\ a=1-\text{cos}.\ 2a$$

Thus we have

$$\begin{aligned}
2\ \text{sin}.^2\ a &= 1-\text{cos}.\ 2a\\
2\ \text{sin}.^2\ (a+d) &= 1-\text{cos}.\ 2(a+d)\\
2\ \text{sin}.^2\ (a+2d) &= 1-\text{cos}.\ 2(a+2d)\\
&\text{\&c.}\\
2\ \text{sin}.^2\ (a+nd) &= 1-\text{cos}.\ 2(a+nd)
\end{aligned}$$

Let

Let $S' = \text{ſin.}^2 a + \text{ſin}^2.\ (a+d) + \text{ſin.}^2\ (a+2d) +,\ \&c. + \text{ſin.}^2\ (a+nd)$

Then, by addition, and obſerving that $\text{coſ.}\ 2a + \text{coſ.}\ 2(a+d) +,\ \&c.\ + \text{coſ.}\ 2(a+nd)$ is by § 360

$$= \frac{\text{coſ.}\ 2a - \text{coſ.}\ 2(a+(n+1)d) + \text{coſ.}\ 2(a+nd) - \text{coſ.}\ 2(a-d)}{2(1-\text{coſ.}\ 2d)}$$

we have

$$2\ S' = n - \frac{\text{coſ.}\ 2a - \text{coſ.}\ 2(a+(n+1)d) + \text{coſ.}\ 2(a+nd) - \text{coſ.}\ 2(a-d)}{2(1-\text{coſ.}\ 2d)}$$

In the ſame manner by forming a ſeries of equations from this theorem $2\ \text{coſ.}^2 a = 1 + \text{coſ.}\ 2a$, and putting

$$\text{coſ.}^2\ a + \text{coſ.}^2\ (a+d) + \text{coſ.}^2\ (a+2d) +,\ \&c.\ + \text{coſ.}^2\ (a+nd)$$

we find

$$2\ C' = n + \frac{\text{coſ.}\ 2a - \text{coſ.}\ 2(a+(n+1)d) + \text{coſ.}\ 2(a+nd) - \text{coſ.}\ 2(a-d)}{2(1-\text{coſ.}\ 2d)}$$

363. If we now ſuppoſe d to be ſuch an arch that $(n+1)d =$ the whole circumference $= 360°$, then $\text{coſ.}\ 2(a+(n+1)d) = \text{coſ.}(2a + 2 \times 360°) = \text{coſ.}\ 2a$, alſo $\text{coſ.}\ 2(a+nd) = \text{coſ.}(2(a-d) + 2 \times 360°) = \text{coſ.}\ 2(a-d)$. Thus it appears that in this particular caſe the numerators of the fractional parts of the values of $2S'$ and $2C'$ are each $=0$, and hence $2S'$ and $2C'$ are each $=n$. We muſt except, however, the caſe of $n=1$, for then $d = 180°$, and $\text{coſ.}\ 2d = 1$, ſo that the denominator of each fraction vaniſhing as well as the numerator, it would be wrong to conclude that the fractions themſelves vaniſh.

Now if the circumference of a circle be divided into $n+1$ equal parts at the points A, A′, A″, &c. (fig. 21.) and any diameter BE, as alſo the ſines AD, A′ D′, A″ D″, &c. be drawn, then, if the arch $BA = a$, and the arch $AA' = d$, we have, as in § 361, $AD = \text{ſin.}\ a$, $A'D' = \text{ſin.}(a+d)$, $A''\ D'' = \text{ſin.}(a+2d)$, &c. and, ſuppoſing the point B to fall between A and A^{iv}, $A^{iv}\ D^{iv} = \text{ſin.}(a+nd)$. Hence we derive the following very elegant and general theorem relating to the circle.

Let the circumference of a circle be divided into n equal parts (where n is any number greater than 2) at the points A, A′, A″, &c.; and from the points of diviſion let the ſines AD, A′D′, A″D″, &c. be drawn perpendicular to any diameter whatever. Twice the ſum of the ſquares of the ſines AD, A′D′, A″D″, &c. is equal to n times the ſquare of the radius of the circle: Alſo twice the ſum of the ſquares of the coſines CD, CD′, C D″, &c. is equal to n times the ſquare of the radius of the circle.

364. We might now proceed to find the ſum of the cubes of the ſines of the arches a, $a+d$, $a+2d$, &c. from the equation

$$4\ \text{ſin.}^3\ a = 3\ \text{ſin}\ a - \text{ſin.}\ 3a$$

and the ſum of the cubes of the coſines from the equation

$$4\ \text{coſ.}^3\ a = 3\ \text{coſ.}\ a + \text{coſ.}\ 3a$$

and thence deduce properties of the circle ſimilar to thoſe which we have found in § 361, and § 363; but as the manner of proceeding in the caſe of the cubes and higher powers, differs not at all from that which we have employed in finding the ſum of their ſquares, we ſhall for the ſake of brevity leave the powers which exceed the ſquare to exerciſe the ingenuity of the reader.

365. The chords of arches poſſeſs properties in all reſpects analogous to thoſe of their ſines. For, from the nature of the chord of an arch

$$\tfrac{1}{2}\ \text{chord}\ a = \text{ſin.}\ \tfrac{1}{2}\ a,\ \text{and}\ \tfrac{1}{2}\ \text{chord. ſupp.}\ a = \text{coſ.}\ \tfrac{1}{2}\ a,$$

Therefore, if in the various theorems, which we have inveſtigated, relating to the ſines and coſines of arches, we ſubſtitute half the chord of the arch for the ſine of half the arch, and half the chord of its ſupplement for its coſine, we ſhall have a new claſs of theorems relating to the chords of arches and the chords of their ſupplements.

366. For example, the 9th and 11th theorems, which may alſo be expreſſed thus,

$$2\,\text{ſin.}(n+1)\tfrac{1}{2}a = 2\,\text{coſ.}\ \tfrac{1}{2}\ a \times 2\ \text{ſin.}\ n\tfrac{1}{2}a - 2\,\text{ſin.}\ (n-1)\tfrac{1}{2}a$$
$$2\,\text{coſ.}(n+1)\tfrac{1}{2}\,a = 2\,\text{coſ.}\ \tfrac{1}{2}\,a \times 2\,\text{coſ.}\ n\tfrac{1}{2}\,a - 2\,\text{coſ.}\ (n-1)\tfrac{1}{2}a$$

by making the propoſed ſubſtitutions are transformed to theſe other two theorems

$$\text{ch.}\ (n+1)a = \text{ch. ſup.}\ a \times \text{ch.}\ na - \text{ch.}\ (n-1)a$$
$$\text{ch. ſup.}(n+1)a = \text{ch. ſup.}\ a \times \text{ch. ſup.}\ na - \text{ch. ſup.}\ (n-1)a$$

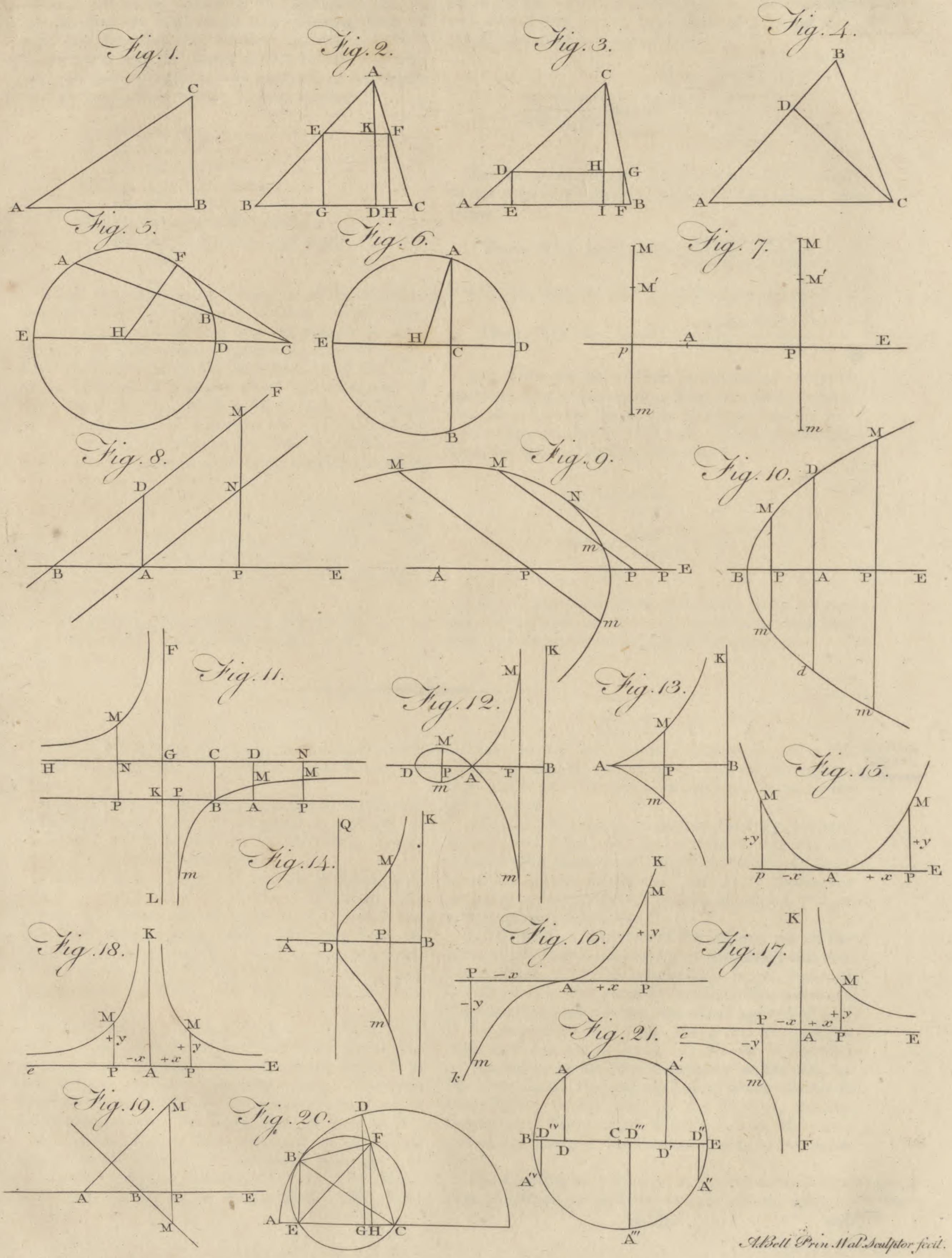
367. Let $x =$ chord of a, and $y =$ chord of its ſupplement, then, putting 0, 1, 2, 3, &c. ſucceſſively for n, and obſerving that $\text{ch.}\ 0\ a = 0$, we obtain from the firſt of theſe theorems the following ſeries of equations

$$\begin{aligned}
&\text{ch.}\ a = x\\
&\text{ch.}\ 2a = xy\\
&\text{ch.}\ 3a = x(y^2-1)\\
&\text{ch.}\ 4a = x(y^3-2y)\\
&\text{ch.}\ 5a = x(y^4-3y^2+1)\\
&\text{ch.}\ 6a = x(y^5-4y^3+3y)\\
&\text{ch.}\ 7a = x(y^6-5y^4+6y^2-1),\\
&\quad \&c.
\end{aligned}$$

Alſo, obſerving that $\text{ch. ſup.}\ 0a =$ diam. $= 2$, we find from the ſecond theorem that

$$\begin{aligned}
&\text{ch. ſup.}\ a = y\\
&\text{ch. ſup.}\ 2a = y^2-2\\
&\text{ch. ſup.}\ 3a = y^3-3y\\
&\text{ch. ſup.}\ 4a = y^4-4y^2+2\\
&\text{ch. ſup.}\ 5a = y^5-5y^3+5y\\
&\text{ch. ſup.}\ 6a = y^6-6y^4+9y^2-2,\\
&\quad \&c.
\end{aligned}$$

If $4-x^2$, and the powers of that quantity be ſubſtituted for y^2, and its powers, in the chords of $3a$, $5a$, $7a$,



A. Bell Prin. Mal. Sculptor fecit.

Arithmetic of Sines.

$7a$, &c. alſo in the chords of the ſupplements of $2a$, $4a$, $6a$, &c. we ſhall obtain the following ſeries of equations expreſſing the relations between the chord of any arch, and the chords of the multiples of that arch, if thoſe multiples be odd numbers, or the chords of their ſupplements, if they be even numbers

$$\begin{aligned} \text{ch. } a &= +x \\ \text{ch. ſup. } 2a &= -x^2+2 \\ \text{ch. } 3a &= -x^3+3x \\ \text{ch. ſup. } 4a &= +x^4-4x^2+2 \\ \text{ch. } 5a &= +x^5-5x^3+5x \\ \text{ch. ſup. } 6a &= -x^6+6x^4-9x^2+2 \\ \text{ch. } 7a &= -x^7+7x^5-14x^3+7x, \\ &\text{\&c.} \end{aligned}$$

Theſe equations are the foundation of the theory of angular ſections, or method of dividing a given angle, or arch of a circle, into any propoſed number of equal parts; a problem which evidently requires for its general algebraic ſolution the determination of the roots of an equation of a degree equal to the number of parts into which the arch is to be divided. By means of the ſame ſeries of equations we may alſo find the ſide of any regular polygon inſcribed in a circle, and in this caſe the multiple arch, being equal to the whole circumference, will have its chord $=0$.

368. The relation between the tangents of any two arches and that of their ſum may be readily found by means of the 1ſt and 3d theorems of this ſection. For ſince $\text{ſin.}\,(a+b)=\text{ſin.}\,a\times\text{coſ.}\,b+\text{coſ.}\,a\times\text{ſin.}\,b$ and $\text{coſ.}\,(a+b)=\text{coſ.}\,a\times\text{coſ.}\,b-\text{ſin.}\,a\times\text{ſin.}\,b$, therefore, dividing the former equation by the latter

$$\frac{\text{ſin.}\,(a+b)}{\text{coſ.}\,(a+b)}=\frac{\text{ſin.}\,a\times\text{coſ.}\,b+\text{coſ.}\,a\times\text{ſin.}\,b}{\text{coſ.}\,a\times\text{coſ.}\,b-\text{ſin.}\,a\times\text{ſin.}\,b}$$

this equation, by dividing each term in the numerator and denominator of the latter part of it by $\text{coſ.}\,a\times\text{coſ.}\,b$, may alſo be expreſſed thus

Arithmetic of Sines.

$$\frac{\text{ſin.}\,(a+b)}{\text{coſ.}\,(a+b)}=\frac{\dfrac{\text{ſin.}\,a}{\text{coſ.}\,a}+\dfrac{\text{ſin.}\,b}{\text{coſ.}\,b}}{1-\dfrac{\text{ſin.}\,a\times\text{ſin.}\,b}{\text{coſ.}\,a\times\text{coſ.}\,b}}$$

But the ſine of any arch divided by its coſine is equal to the tangent of that arch, hence the laſt equation becomes

$$\text{Theor. XIII. tan.}\,(a+b)=\frac{\text{tan.}\,a+\text{tan.}\,b}{1-\text{tan.}\,a\times\text{tan.}\,b}$$

and by ſuppoſing the arch b negative, we alſo find

$$\text{Theor. XIV. tan.}\,(a-b)=\frac{\text{tan.}\,a-\text{tan.}\,b}{1+\text{tan.}\,a\times\text{tan.}\,b}$$

365. From the firſt of theſe two theorems a ſeries of equations may be derived expreſſing the relations which take place between the tangent of an arch and the tangent of any multiple of that arch. Thus by aſſuming $b=a$, $2a$, &c. and putting t for tan. a

$$\text{tan. } 2a=\frac{2t}{1-t^2}$$

$$\text{tan. } 3a=\frac{3t-t^3}{1-3t^2},$$

&c.

and hence the tangent of an arch being given, the tangent of any part of that arch, as its half, third, &c. may be found by the reſolution of an equation.

A L G

Algedo ‖ Algiabarii.

ALGEDO, a ſuppreſſed gonorrhœa, a name which occurs in old authors. See GONORRHOEA, MEDICINE *Index*.

ALGENEB, a fixed ſtar of the ſecond magnitude, in Perſeus's right ſide. Its longitude is 27° 46′ 12″ of Taurus, and its latitude 30° 50′ 28″ north, according to Mr Flamſtead's catalogue.

ALGEZIRA, a town of Andaluſia in Spain, with a port on the coaſt of the ſtraits of Gibraltar. By this city the Moors entered Spain in 713; and it was taken from them in 1344, after a very long ſiege, remarkable for being the firſt in which cannon were made uſe of. It was called *Old Gibraltar*, and is about four leagues from the New. W. Long. 5. 20. N. Lat. 36. 0.

ALGHIER, or ALGERI, a town in Sardinia, with a biſhop's ſee, upon the weſtern coaſt of the iſland, between Saſſeri and Boſa. Though it is not large, it is well peopled, and has a commodious port. The coral fiſhed for on this coaſt is in the higheſt eſteem of any in the Mediterranean. W. Long. 4. 2. N. Lat. 36. 0.

ALGIABARII, a Mahometan ſect of predeſtinarians, who attribute all the actions of men, good or evil, to the agency or influence of God. The Algiabarii ſtand oppoſed to the ALKADARII. They hold abſolute decrees and phyſical promotion. For the juſtice of God in puniſhing the evil he has cauſed, they reſolve it wholly into his abſolute dominion over the creatures.

A L G

Algidum, Algiers.

ALGIDUM, a town of Latium, in Italy, between Preneſte and Alba, near the mountains. On the top of one of theſe mountains was erected a temple of Diana, to which Horace refers, lib. i. od. 21. "*Quæcunque aut gelido prominet Algido*," and lib. iii. od. 23. "*Quæ nivali paſcitur Algido*, &c."

ALGIERS, a kingdom of Africa, now one of the ſtates of Barbary.—According to the lateſt and beſt computations, it extends 460 miles in length from eaſt to weſt; but is very unequal in breadth, ſome places being ſcarcely 40 miles broad, and others upward of 100. It lies between Long. 0. 16. and 9. 16. W. and extends from Lat 36. 55. to 44. 50. N.—It is bounded on the north, by the Mediterranean; on the eaſt, by the river Zaine, the ancient Tuſca, which divides it from Tunis; on the weſt, by the Mulvya, and the mountains of Trava, which ſeparate it from Morocco; and on the ſouth by the Sahara, Zaara, or Numidian deſert.

Diviſion of the kingdom.

The kingdom of Algiers is at preſent divided into three provinces or diſtricts, viz. the eaſtern, weſtern, and

Algiers. and ſouthern. The eaſtern or Levantine government, which is by far the moſt conſiderable of the three, and is alſo called *Beylick*, contains the towns of Bona, Conſtantina, Gigeri, Bujeya, Steffa, Tebef, Zamoura, Biſcara, and Necanz, in all which the Turks have their garriſons: beſides which, it includes the two ancient kingdoms of Cuco and Labez, though independent of the Algerine government, to whoſe forces their country is inacceſſible; ſo that they ſtill live under their own cheyks choſen by each of their adowars or hords. To theſe we may add a French factory at Callo, under the direction of the company of the French Baſtion.—The weſtern government hath the towns of Oran, Tremecen, Moſtagan, Tenez, and Secrelly with its caſtle and garriſon.—The ſouthern government hath neither town, village, nor even a houſe, all the inhabitants living in tents, which obliges the dey and his forces to be always encamped.

Inhabitants. The inhabitants along the ſea coaſts are a mixture of different nations; but chiefly Moors and Moreſcos driven out of Catalonia, Arragon, and other parts of Spain. Here are alſo great numbers of Turks, who come from the Levant to ſeek their fortune; as well as multitudes of Jews and Chriſtians taken at ſea, who are brought hither to be ſold for ſlaves. The Berebers are ſome of the moſt ancient inhabitants of the country; and are ſuppoſed to be deſcended from the ancient Sabeans, who came hither from Arabia Felix under the conduct of one of their princes. Others believe them to be ſome of the Canaanites driven out of Paleſtine by Joſhua. Theſe are diſperſed all over Barbary, and divided into a multitude of tribes under their reſpective chiefs: moſt of them inhabit the mountainous parts; ſome range from place to place, and live in tents, or portable huts; others in ſcattered villages: they have nevertheleſs, kept themſelves for the moſt part from intermixing with other nations. The Berebers are reckoned the richeſt of all, go better clothed, and carry on a much larger traffic of cattle, hides, wax, honey, iron, and other commodities. They have alſo ſome artificers in iron, and ſome manufacturers in the weaving branch.—The name of *Bereber* is ſuppoſed to have been originally given them on account of their being firſt ſettled in ſome deſert place. Upon their increaſing in proceſs of time, they divided themſelves into five tribes, probably on account of religious differences, called the *Zinhagians*, *Muſamedins*, *Zeneti*, *Hoares*, and *Gomeres;* and theſe having produced 600 families, ſubdivided themſelves into a great number of petty tribes.—To theſe we may add the *Zwowahs*, by European authors called *Azuagues*, or *Aſſagues*, who are likewiſe diſperſed over moſt parts of Barbary and Numidia. Great numbers of theſe inhabit the mountainous parts of Cuco, Labez, &c. leading a wandering paſtoral life. But the moſt numerous inhabitants are the Moors and Arabians. The former are very ſtout and warlike, and ſkilful horſemen; but ſo addicted to robbing, that one cannot ſafely travel along the country at a diſtance from the towns without a guard, or at leaſt a marabout or ſaint for a ſafeguard. For as they look upon themſelves to be the original proprietors of the country, and not only as diſpoſſeſſed by the reſt of the inhabitants, but reduced by them to the loweſt ſtate of poverty, they make no ſcruple to plunder all they meet by way of repriſal. The inhabitants in general have a pretty fair complexion; they are robuſt and well proportioned. People of diſtinction wear their beard; they have rich clothes made of ſilk, embroidered with flowers of gold, and turbans enriched with jewels. The Turks, who compoſe the military force, have great privileges, pay no taxes, are never publicly puniſhed, and rarely in private. The loweſt ſoldier domineers over the moſt diſtinguiſhed Moors at pleaſure. If he finds them better mounted than himſelf, he exchanges horſes without ceremony. The Turks alone have the privilege of carrying fire arms. Many good qualities, however, diſtinguiſh them in ſpite of this exceſs of deſpotiſm. They never game for money, not even for trifles; and they never profane the name of the Deity. They ſoon forget their private quarrels; and after the firſt paroxyſm of reſentment is over, it is infamy for a Turk to keep in remembrance the injuries he has received. In this reſpect certainly they are leſs barbarous than other nations that boaſt of their civilization. See Moors.

Climate and ſoil. The climate of Algiers is in moſt places ſo temperate, that there is a conſtant verdure; the leaves of the trees being neither parched up by heat in ſummer, nor nipped by the winter's cold. They begin to bud in February; in April the fruit appears in its full bigneſs, and is commonly ripe in May. The ſoil, however, is exceſſively various; ſome places being very hot, dry, and barren, on which account they are generally ſuffered to lie uncultivated by the inhabitants, who are very negligent. Theſe barren places, eſpecially ſuch as lie on the ſouthern ſide, and are at a great diſtance from the ſea, harbour vaſt numbers of wild animals, as lions, tigers, buffaloes, wild boars, ſtags, porcupines, monkeys, oſtriches, &c. On account of their barrenneſs, they have but few towns, and thoſe thinly peopled; though ſome of them are ſo advantageouſly ſituated for trading with Bildulgerid and Negroland, as to drive a conſiderable traffic with them.

Rivers. The moſt conſiderable rivers of Algiers are (1.) the or Ziz, which runs acroſs the province of Tremecen and the deſert of Anguid, falling into the Mediterranean near the town of Tabecrita, where it has the name of *Sirut*. (2.) The Haregol, ſuppoſed the *Sign* of Ptolemy, comes down from the great Atlas, croſſes the deſert of Anguid, and falls into the ſea about five leagues from Oran. (3.) The Mina, ſuppoſed the *Chylematis* of Ptolemy, a large river, which runs through the plains of Bathala, and falls into the ſea near the town of Arzew. This river hath lately received the name of *Cena*, who rebuilt the town of Barthalaw after it had been deſtroyed. (4.) The Shellif, Zilef or Zilif, deſcending from the Mount Gnanexeris, runs through ſome great deſerts, the lake Titteri, the frontiers of Tremecen, and Tenez, falling into the ſea a little above the city of Moſtagan. (5.) The Celef, ſuppoſed to be the *Carthena* of the ancients, falls into the ſea about three leagues weſt of Algiers, after a ſhort courſe of 18 or 20 leagues. (6.) The Hued-alquivir, ſuppoſed to be the *Nalabata* or *Naſaba* of the ancients, and called by the Europeans *Zinganir*, runs down with a ſwift courſe through ſome high mountains of Cuco, and falls into the ſea near Bujeyah. Whilſt the city of Bujeyah was in the hands of the Chriſtians, the mouth of this river was ſo choked up with ſand, that no veſſel could come up into it: but in 1555,

Harbour of Bujeyah cleared by accident.

Algiers.

1555, very foon after it was taken by the Moors, the great rains fwelled it to fuch a degree, that all the fand and mud was carried off; fo that galleys and other veffels have ever fince entered it with eafe, where they lie fafe from ftorms, and all winds but that which blows from the north. (7.) Suf-Gemar, or Suf-Gimmar al Rumniel, fuppofed to be the *Ampfaga* of Ptolemy, hath its fource in Mount Auras, on the confines of Atlas; thence runs through fome barren plains, and the fruitful ones of Conftantina, where its ftream is greatly increafed by fome other rivers it receives; from thence running northward, along the ridges of fome high mountains, it falls into the fea a little eaft of Gigeri. (8.) The Ladag, or Ludeg, runs down from Mount Atlas through part of Conftantina, and falls into the fea a little eaftward of Bona. (9.) Guadi, or Guadel Barbar, fprings from the head of Orbus, or Urbs, in Tripoli, runs through Bujeyah, and falls into the fea near Tabarea.

The Algerine kingdom made formerly a confiderable part of the Mauritania Tingitana (fee MAURITANIA), which was reduced to a Roman province by Julius Cæfar, and from him alfo called *Mauritania Cæfarienfis*.—In the general account of Africa, it has been noticed, that the Romans were driven out of that continent by the Vandals; thefe by Belifarius, the Greek emperor Juftinian's general; and the Greeks in their turn by the Saracens. This laft revolution happened about the middle of the feventh century; and the Arabs continued mafters of the country, divided into a great number of petty kingdoms or ftates, under chiefs of their own choofing, till the year 1051. This year, one Abubeker-ben-Omar, or, as the Spanifh authors call him, *Abu-Texefien*, an Arab of the Zinhagian tribe, being provoked at the tyranny of thofe defpots, gathered, by the help of his marabouts or faints, a moft powerful army of malcontents, in the fouthern provinces of Numidia and Libya. His followers were nicknamed *Marabites* or *Morabites*; by the Spaniards *Almoravides*; probably from their being affembled principally by the faints who were alfo called *Morabites*. The caliph of Kayem's forces were at this time taken up with quelling other revolts in Syria, Mefopotamia, &c. and the Arabs in Spain engaged in the moft bloody wars; fo that Texefien having nothing to fear from them, had all the fuccefs he could wifh againft the Arabian cheyks or petty tyrants, whom he defeated in many battles, and at laft drove them not only out of Numidia and Libya, but out of all the weftern parts, reducing the whole province of Tingitania under his dominion.

Abu-Texefien fubdues the Arab princes.

Texefien was fucceeded by his fon Yufef, or Jofeph, a brave and warlike prince. In the beginning of his reign, he laid the foundation of the city of Morocco, which he defigned to make the capital of his empire. While that city was building, he fent fome of his marabouts ambaffadors to Tremecen (now a province of Algiers), at that time inhabited by a powerful and infolent fect of Mahometans called *Zeneti*. The defign of this embaffy was to bring them back to what he called the *true faith*; but the Zeneti, defpifing his offers, affembled at Amaf, or Amfa, their capital, murdered the ambaffadors, and invaded Jofeph's dominions with an army of 50,000 men.

Zeneti deftroyed.

The king hearing of their infamous proceedings, fpeedily muftered his army, and led it by long marches into their country, deftroying all with fire and fword; while the Zeneti, inftead of oppofing his progrefs, retired as faft as poffible towards Fez, in hopes of receiving affiftance from thence. In this they were miferably deceived: the Fezzans marched out againft them in a hoftile manner; and coming up with the unhappy Zeneti, encumbered with their families and baggage, and ready to expire with hunger and wearinefs, they cut them all to pieces, except a fmall number who were moftly drowned in attempting to fwim acrofs a river, and fome others who in their flight perifhed by falling from the high adjacent rocks. In the mean time Jofeph reduced their country to a mere defert: which was, however, foon peopled by a numerous colony of Fezzans, who fettled there under the protection of the reigning kings. In this war it is computed that near a million of the Zeneti, men, women, and children, loft their lives.

The reftlefs and ambitious temper of Jofeph did not let him remain long at peace. He quickly declared war againft the Fezzans, reduced them to become his tributaries, and extended his conquefts all along the Mediterranean. He next attacked fome Arabian cheyks who had not yet fubmitted to his jurifdiction; and purfued them with fuch fury, that neither the Libyan deferts, nor ridges of the moft craggy rocks, could fhelter them from his arms. He attacked them in fuch of their retreats, caftles, and fortreffes, as were till then deemed impregnable; and at laft fubdued them, to the great grief of the other African nations, who were greatly annoyed by the ravages committed by his numerous forces.

Thus was founded the empire of the Morabites: which, however, was of no long duration; that race being in the 12th century driven out by Mohavedin, a marabout. This race of priefts was expelled by Abdulac governor of Fez; and he, in the 13th century, ftripped of his new conquefts by the fharifs of *Hafcen*, the defcendants of thofe Arabian princes whom Abu-Texefien had formerly expelled.

Sharifs of Hafcen, who.

The better to fecure their new dominions, the fharifs divided them into feveral little kingdoms or provinces; and among the reft the prefent kingdom of Algiers was divided into four, namely, *Tremecen*, *Tenez*, *Algiers Proper*, and *Bujeyah*. The four firft monarchs laid fo good a foundation for a lafting balance of power between their little kingdoms, that they continued for fome centuries in mutual peace and amity; but at length the king of Tremecen having ventured to violate fome of their articles, Abul-Farez, king of Tenez, declared war againft him, and obliged him to become his tributary. This king dying foon after, and having divided his kingdom among his three fons, new difcords arofe; which Spain taking advantage of, a powerful fleet and army was fent againft Barbary, under the count of Navarre, in 1505. This commander foon made himfelf mafter of the important cities of Oran, Bujeyah, and fome others; which fo alarmed the Algerines, that they put themfelves under the protection of Selim Eutemi, a noble and warlike Arabian prince. He came to their affiftance with a great number of his braveft fubjects, bringing with him his wife Zaphira, and a fon then about 12 years old. This, however, was not fufficient to prevent the Spaniards

Algerines in danger from the Spaniards.

Algiers. niards from landing a number of forces near Algiers that same year, and obliging that metropolis to become tributary to Spain. Nor could Prince Selim hinder them from building a ſtrong fort on a ſmall iſland oppoſite to the city, which terrified their corſairs from ſailing either in or out of the harbour.

Invite Barbaroſſa. To this galling yoke the Algerines were obliged to ſubmit till the year 1516; when, hearing of the death of Ferdinand king of Spain, they ſent an embaſſy to *Aruch Barbaroſſa*, who was at this time no leſs dreaded for his valour than his ſurpriſing ſucceſs, and was then ſent on a cruiſe with a ſquadron of galleys and barks. The purport of the embaſſy was, that he ſhould come and free them from the Spaniſh yoke; for which they agreed to pay him a gratuity anſwerable to ſo great a ſervice. Upon this Barbaroſſa immediately deſpatched 18 galleys and 30 barks to the aſſiſtance of the Algerines: while he himſelf advanced towards the city with 800 Turks, 3000 Jigelites, and 2000 Mooriſh volunteers. Inſtead of taking the neareſt road to Algiers, he directed his courſe towards *Sharſhel*, where *Haſſan*, another famed corſair, had ſettled himſelf. Him he ſurpriſed, and obliged to ſurrender; not without a previous promiſe of friendſhip: but no ſooner had Barbaroſſa got him in his power, than he cut off his head; and obliged all Haſſan's Turks to follow him in his new expedition.

His treachery and cruelty. On Barbaroſſa's approach to Algiers, he was met by Prince Eutemi, attended by all the people of that metropolis, great and ſmall; who looked for deliverance from this abandoned villain, whom they accounted invincible. He was conducted into the city amidſt the acclamations of the people, and lodged in one of the nobleſt apartments of Prince Eutemi's palace, where he was treated with the greateſt marks of diſtinction. Elated beyond meaſure with this kind reception, Barbaroſſa formed a deſign of becoming king of Algiers; and fearing ſome oppoſition from the inhabitants, on account of the exceſſes he ſuffered his ſoldiers to commit, murdered Prince Eutemi, and cauſed himſelf to be proclaimed king; his Turks and Moors crying out as he rode along the ſtreets, "Long live King Aruch Barbaroſſa, the invincible king of Algiers, the *choſen of God* to deliver the people from the oppreſſion of the Chriſtians; and deſtruction to all that ſhall oppoſe, or refuſe to own him as their lawful ſovereign." Theſe laſt threatening words ſo intimidated the inhabitants, already apprehenſive of a general maſſacre, that he was immediately acknowledged king. The unhappy princeſs Zaphira, it is ſaid, poiſoned herſelf, to avoid the brutality of this new king, whom ſhe unſucceſsfully endeavoured to ſtab with a dagger.

Barbaroſſa was no ſooner ſeated on the throne, than he treated his ſubjects with ſuch cruelty, that they uſed to ſhut up their houſes and hide themſelves when he appeared in public. In conſequence of this, a plot was ſoon formed againſt him; but being diſcovered, he cauſed twenty of the principal conſpirators to be beheaded, their bodies to be buried in a dunghill, and laid a heavy fine on thoſe who ſurvived. This ſo terrified the Algerines, that they never afterwards durſt attempt any thing againſt either Barbaroſſa or his ſucceſſors.

In the mean time, the ſon of Prince Eutemi having fled to Oran, and put himſelf under the protection of the marquis of Gomarez, laid before that nobleman a plan for putting the city of Algiers into the hands of the king of Spain. Upon this, young Selim Eutemi was ſent to Spain, to lay his plan before Cardinal Ximenes; who having approved of it, ſent a fleet with 10,000 land forces, under the command of *Don Franciſco*, or, as others call him, *Don Diego de Vera*, to drive out the Turks, and reſtore the young prince. But the fleet was no ſooner come within ſight of land, than it was diſperſed by a ſtorm, and the greateſt part of the ſhips daſhed againſt the rocks. Moſt of the Spaniards were drowned; and the few who eſcaped to ſhore were either killed by the Turks or made ſlaves.

Though Barbaroſſa had nothing to boaſt on this occaſion, his pride and inſolence were now ſwelled to ſuch a degree, that he imagined himſelf invincible, and that the very elements conſpired to make him ſo. The Arabians were ſo much alarmed at his ſucceſs, that they implored the aſſiſtance of Hamidel Abdes king of Tenez, to drive the Turks out of Algiers. That prince readily undertook to do what was in his power for this purpoſe, provided they agreed to ſettle the kingdom on himſelf and his deſcendants. This propoſal being accepted, he immediately ſet out at the head of 10,000 Moors; and, upon his entering the Algerine dominions, was joined by all the Arabians in the country. Barbaroſſa engaged him, only with 1000 Turkiſh muſqueteers and 500 Granada Moors; totally defeated his numerous army; purſued him to the very gates of his capital, which he eaſily made himſelf maſter of; and having given it up to be plundered by the Turks, obliged the inhabitants to acknowledge him as their ſovereign. This victory, however, was chiefly owing to the advantage which his troops had from their fire-arms; the enemy having no other weapons than arrows and javelins.

No ſooner was Barbaroſſa become maſter of the kingdom of Tenez, than he received an embaſſy from the inhabitants of Tremecen; inviting him to come to their aſſiſtance againſt their then reigning prince, with whom they were diſſatisfied on account of his having dethroned his nephew, and forced him to fly to Oran; offering him even the ſovereignty, in caſe he accepted of their propoſal. The king of Tremecen, not ſuſpecting the treachery of his ſubjects, met the tyrant with an army of 6000 horſe and 3000 foot: but Barbaroſſa's artillery gave him ſuch an advantage, that the king was at length forced to retire into the capital; which he had no ſooner entered, than his head was cut off, and ſent to Barbaroſſa, with a freſh invitation to come and take poſſeſſion of the kingdom. On his approach, he was met with by the inhabitants, whom he received with complaiſance, and many fair promiſes; but beginning to tyrannize as uſual, his new ſubjects ſoon convinced him that they were not ſo paſſive as the inhabitants of Algiers. Apprehending, therefore, that his reign might prove uneaſy and precarious, he entered into an alliance with the king of Fez; after which, he took care to ſecure the reſt of the cities in his new kingdom, by garriſoning them with his own troops. Some of theſe, however, revolted ſoon after; upon which he ſent one of his corſairs, named *Eſcander*, a man no leſs cruel than himſelf, to reduce them. The Tremecenians now began to repent

Algiers. pent in good earnest of their having invited such a tyrant to their assistance; and held consultations on the most proper means of driving him away, and bringing back their lawful prince *Abuchen Men*: but their cabals being discovered, a great number of the conspirators were massacred in the most cruel manner. The prince had the good luck to escape to Oran, and was taken under the protection of the marquis of Gomarez, who sent immediate advice of it to Charles V. then lately arrived in Spain, with a powerful fleet and army. That monarch immediately ordered the young king a succour of 10,000 men, under the command of the governor of Oran; who, under the guidance of Abuchen Men, began his march towards Tremecen; and in their way they were joined by Prince Selim, with a great number of Arabs and Moors. The first thing they resolved upon was, to attack the important fortress of *Calau*, situated between Tremecen and Algiers, and commanded by the corsair Escander at the head of about 300 Turks. They invested it closely on all sides, in hopes Barbarossa would come out of Tremecen to its relief, which would give the Tremecenians an opportunity of keeping him out. That tyrant, however, kept close in his capital, being embarrassed by his fears of a revolt, and the politic delays of the king of Fez, who had not sent the auxiliaries he promised. The garrison of Calau, in the meantime, made a brave defence; and, in a sally they made at night, cut off near 300 Spaniards. This encouraged them to venture a second time; but they were now repulsed with great loss, and Escander himself wounded: soon after which, they surrendered upon honourable terms; but were all massacred by the Arabians, except 16, who clung close to the stirrups of the king, and of the Spanish general.

Barbarossa being now informed that Abuchen Men, with his Arabs, accompanied by the Spaniards, were in full march to lay siege to Tremecen, thought proper to come out, at the head of 1500 Turks and 5000 Moorish horse, in order to break his way through the enemy; but he had not proceeded far from the city, before his council advised him to return and fortify himself in it. This advice was now too late; the inhabitants being resolved to keep him out, and open their gates to their own lawful prince as soon as he appeared. In this distress Barbarossa saw no way left but to retire to the citadel, and there defend himself till he could find an opportunity of stealing out with his men and all his treasure. Here he defended himself vigorously; but his provisions failing him, he took advantage of a subterraneous back way, which he had caused to be digged up for that purpose; and, taking his immense treasure with him, stole away as secretly as he could. His flight, however, was soon discovered; and he was so closely pursued, that to amuse, as he hoped, the enemy, he caused a great deal of his money, plate, jewels, &c. to be scattered all the way, thinking they would not fail to stop their pursuit to gather it up. This stratagem, however, failed, through the vigilance of the Spanish commander, who being himself at the head of the pursuers, obliged them to march on, till he was come up close to him on the banks of the *Huexda*, about eight leagues from Tremecen. Barbarossa had just crossed the river with his vanguard, when the Spaniards came up with his rear on the other side, and cut them all off; and then crossing the water, overtook him at a small distance from it. Here a bloody engagement ensued, in which the Turks fought like as many lions; but, being at length overpowered by numbers, they were all cut to pieces, and Barbarossa among the rest, in the 44th year of his age, and four years after he had raised himself to the royal title of *Jigel* and the adjacent country; two years after he had acquired the sovereignty of Algiers, and scarce a twelvemonth after the reduction of Tremecen. His head was carried to Tremecen on the point of a spear; and Abuchen Men proclaimed king, to the joy of all the inhabitants. A few days after the fight, the king of Fez made his appearance at the head of 20,000 horse, near the field of battle; but hearing of Barbarossa's defeat and death, marched off with all possible speed, to avoid being attacked by the enemy.

Algiers. Barbarossa defeated and killed by the Spaniards.

Succeeded by Hayradin.

The news of Barbarossa's death spread the utmost consternation among the Turks at Algiers: however, they caused his brother Hayradin to be immediately proclaimed king. The Spanish commander now sent back the emperor's forces, without making any attempt upon Algiers; by which he lost the opportunity of driving the Turks out of that country; while Hayradin, justly dreading the consequences of the tyranny of his officers, sought the protection of the Grand Signior. This was readily granted, and himself appointed bashaw or viceroy of Algiers; by which means he received such considerable reinforcements, that the unhappy Algerines durst not make the least complaint; and such numbers of Turks resorted to him, that he was not only capable of keeping the Moors and Arabs in subjection at home, but of annoying the Christians at sea. His first step was to take the Spanish fort above mentioned, which was a great nuisance to his metropolis. The Spaniards held out to the last extremity; but being all slain or wounded, Hayradin easily became master of the place.

He takes the Spanish fort.

Hayradin next set about building a strong mole for the safety of his ships. In this he employed 30,000 Christian slaves, whom he obliged to work without intermission for three years; in which time the work was completed. He then caused the fort he had taken from the Spaniards to be repaired, and placed a strong garrison in it, to prevent any foreign vessels from entering the harbour without giving an account of themselves. By these two important works, Hayradin soon became dreaded not only by the Arabs and Moors, but also by the maritime Christian powers, especially the Spaniards. The viceroy failed not to acquaint the Grand Signior with his success, and obtained from him a fresh supply of money, by which he was enabled to build a stronger fort, and to erect batteries on all places that might favour the landing of an enemy. All these have since received greater improvements from time to time, as often as there was occasion for them.

Succeeded by Hassan Aga.

In the mean time the sultan, either out of a sense of the great services Hayradin had done, or perhaps out of jealousy lest he should make himself independent, raised Hayradin to the dignity of bashaw of the empire, and appointed Hassan Aga, a Sardinian renegado, an intrepid warrior, and an experienced officer, to succeed him as bashaw of Algiers. Hassan had no sooner taken possession of his new government, than he began to pursue his ravages on the Spanish coast with greater-

Algiers.

Charles V.'s expedition against Algiers.

greater fury than ever; extending them to the ecclesiastical state, and other parts of Italy. But Pope Paul III. being alarmed at this, exhorted the emperor Charles V. to send a powerful fleet to suppress those frequent and cruel piracies; and, that nothing might be wanted to rendered the enterprise successful, a bull was published by his holiness, wherein a plenary absolution of sins, and the crown of matyrdom, was promised to all those who either fell in battle or were made slaves; the emperor on his part needed no spur; and therefore set sail at the head of a powerful fleet consisting of 120 ships and 20 galleys, having on board 30,000 chosen troops, and an immense quantity of money, arms, ammunition, &c. In this expedition many young nobility and gentry attended as volunteers, and among these many knights of Malta, so remarkable for their valour against the enemies of Christianity. Even ladies of birth and character attended Charles in his expedition, and the wives and daughters of the officers and soldiers followed them with a design to settle in Barbary after the conquest was finished. All these meeting with a favourable wind, soon appeared before Algiers; every ship displaying the Spanish colours on the stern, and another at the head, with a crucifix to serve them for a pilot.

Algiers in great consternation.

By this prodigious armament, the Algerines were thrown into the utmost consternation. The city was surrounded only by a wall with scarce any outworks. The whole garrison consisted of 800 Turks and 6000 Moors, without fire-arms, and poorly disciplined and accoutred; the rest of their forces being dispersed in the other provinces of the kingdom, to levy the usual tribute on the Arabs and Moors. The Spaniards landed without opposition, and immediately built a fort, under the cannon of which they encamped, and diverted the course of a spring which supplied the city with water. Being now reduced to the utmost distress, Hassan received a summons to surrender at discretion, on pain of being put to the sword with all the garrison. The herald was ordered to extol the vast power of the emperor both by sea and land, and to exhort him to return to the Christian religion. But to this Hassan only replied, that he must be a madman who would pretend to advise an enemy, and that the advised must still act more madly who would take counsel of such an adviser. He was, however, on the point of surrendering the city, when advice was brought him that the forces belonging to the western government were in full march towards the place; upon which it was resolved to defend it to the utmost. Charles, in the mean time, resolving upon a general assault, kept a constant firing upon the town; which, from the weak defence made by the garrison, he looked upon as already in his hands. But while the *douwan*, or Algerine senate, were deliberating on the most proper means of obtaining an honourable capitulation, a mad prophet, attended by a multitude of people, entered the assembly, and foretold the speedy destruction of the Spaniards before the end of the moon, exhorting the inhabitants to hold out till that time. This prediction was soon accomplished in a very surprising and unexpected manner: for, on the 28th of October 1541, a dreadful storm of wind, rain, and hail, arose from the north, accompanied with violent shocks of earthquakes, and a dismal and universal darkness both by sea and land; so that the sun, moon, and elements, seemed to combine together for the destruction of the Spaniards. In that one night, some say in less than half an hour, 86 ships and 15 galleys were destroyed, with all their crews and military stores; by which the army on shore was deprived of all means of subsisting in these parts. Their camp also, which spread itself along the plain under the fort, was laid quite under water by the torrents which descended from the neighbouring hills. Many of the troops, by trying to remove into some better situation, were cut in pieces by the Moors and Arabs; while several galleys and other vessels, endeavouring to gain some neighbouring creeks along the coasts, were immediately plundered, and their crews massacred, by the inhabitants.

Prevented by a mad prophet from surrendering.

Spanish fleet destroyed by a storm.

Siege of Algiers raised.

The next morning Charles beheld the sea covered with the fragments of so many ships, and the bodies of men, horses, and other creatures, swimming on the waves; at which he was so disheartened, that abandoning his tents, artillery, and all his heavy baggage, to the enemy, he marched at the head of his army, though in no small disorder, towards Cape *Malabux*, in order to reimbark in those few vessels which had outweathered the storm. But Hassan, who had caused his motions to be watched, allowed him just time to get to the shore, when he sallied out and attacked the Spaniards in the midst of their hurry and confusion to get into their ships, killing great numbers, and bringing away a still greater number of captives; after which he returned in triumph to Algiers, where he celebrated with great rejoicings his happy deliverance from such distress and danger.

The mad prophet rewarded.

Soon after this, the prophet *Yusef*, who had foretold the destruction of the Spaniards, was not only declared the deliverer of his country, but had a considerable gratuity decreed him, with the liberty of exercising his prophetic function unmolested. It was not long, however, before the marabouts, and some interpreters of the law, made a strong opposition against him; remonstrating to the bashaw, how ridiculous and scandalous it was to their nation, to ascribe the deliverance of it to a poor fortune-teller, which had been obtained by the fervent prayers of an eminent saint of their own profession. But though the bashaw and his douwan seemed, out of policy, to give into this last notion, yet the impression which Yusef's predictions and their late accomplishments had made upon the minds of the common people, proved too strong to be eradicated; and the spirit of divination and conjuring has since got into such credit among them, that not only their great statesmen, but their priests, marabouts, and santoons, have applied themselves to that study, and dignified it with the name of *Mahomet's Revelations*.

Fresh calamities of the Spaniards.

The unhappy Spaniards had scarcely reached their ships, when they were attacked by a fresh storm, in which several more of them perished; one ship in particular, containing 700 soldiers, besides sailors, sunk in the emperor's sight, without a possibility of saving a single man. At length, with much labour, they reached the port of *Bujeyah*, at that time possessed by the Spaniards, whither Hassan king of Tunis soon after repaired, with a supply of provisions for the emperor, who received him graciously, with fresh assurances of his favour and protection. Here he dismissed the few remains of the Maltese knights and their forces, who embarked in three shattered galleys, and with much difficulty

Algiers.

ficulty and danger reached their own country. Charles himſelf ſtaid no longer than till the 16th of November, when he ſet ſail for Carthagena, and reached it on the 25th of the ſame month. In this unfortunate expedition upwards of 120 ſhips and galleys were loſt, above 300 colonels and other land and ſea officers, 8000 ſoldiers and marines, beſides thoſe deſtroyed by the enemy on the reimbarkation, or drowned in the laſt ſtorm. The number of priſoners was ſo great, that the Algerines ſold ſome of them, by way of contempt, for an onion per head.

Haſſan reduces Tremecen.

Haſſan, elated with this victory, in which he had very little ſhare, undertook an expedition againſt the king of Tremecen, who, being now deprived of the aſſiſtance of the Spaniards, was forced to procure a peace by paying a vaſt ſum of money, and becoming tributary to him. The baſhaw returned to Algiers, laden with riches; and ſoon after died of a fever, in the 66th year of his age.

Bujeyah taken from the Spaniards.

From this time the Spaniards were never able to annoy the Algerines in any conſiderable degree. In 1555, they loſt the city of Bujeyah, which was taken by *Salha Rais*, Haſſan's ſucceſſor; who next year ſet out on a new expedition, which he kept a ſecret, but was ſuſpected to be intended againſt Oran; but he was ſcarcely got four leagues from Algiers, when the plague, which at that time raged violently in the city, broke out in his groin, and carried him off in 24 hours.

Haſſan Corſo choſen baſhaw by the janizaries.

Immediately after his death the Algerine ſoldiery choſe a Corſican renegado, Haſſan Corſo, in his room, till they ſhould receive farther orders from the Porte. He did not accept of the baſhawſhip without a good deal of difficulty; but immediately proſecuted the intended expedition againſt Oran, deſpatching a meſſenger to acquaint the Porte with what had happened. They had hardly begun their hoſtilities againſt the place, when orders came from the Porte, expreſsly forbidding Haſſan Corſo to begin the ſiege, or, if he had begun it, enjoining him to raiſe it immediately. This news was received with great grief by the whole fleet and army, as they thought themſelves ſure of ſucceſs, the garriſon being at that time very weak. Neverthelefs, as they dared not diſobey, the ſiege was immediately raiſed.

Superſeded by Tekelli, who puts him to a cruel death.

Corſo had hardly enjoyed his dignity four months, before news came, that eight galleys were bringing a new baſhaw to ſucceed him; one *Tekelli*, a principal Turk of the Grand Signior's court: upon which the Algerines unanimouſly reſolved not to admit him. By the treachery of the Levantine ſoldiers, however, he was admitted at laſt, and the unfortunate Corſo thrown over a wall in which a number of iron hooks were fixed; one of which catching the ribs of his right ſide, he hung three days in the moſt exquiſite torture before he expired.

Tekelli had no ſooner entered upon his new government, than he behaved with ſuch cruelty and rapacioufneſs, that he was aſſaſſinated even under the dome of a ſaint, by Yuſef Calabres, the favourite renegado of Haſſan Corſo; who for this ſervice was unanimouſly choſen baſhaw, but died of the plague ſix days after his election.

Haſſan reinſtated.

Yuſef was ſucceeded by Haſſan the ſon of Hayradin, who had been formerly recalled from his baſhawſhip, when he was ſucceeded by Salha Rais; and now had the good fortune to get himſelf reinſtated in his employment. Immediately on his arrival, he engaged in a war with the Arabs, by whom he was defeated with great loſs. The next year, the Spaniards undertook an expedition againſt Moſtagan, under the command of the count d'Alcandela; but were utterly defeated, the commander himſelf killed, and 12,000 men taken priſoners. This diſaſter was owing to the inconſiderate raſhneſs, or rather madneſs, of the commander; which was ſo great, that, after finding it impoſſible to rally his ſcattered forces, he ruſhed, ſword in hand, into the thickeſt of the enemy's ranks, at the head of a ſmall number of men, crying out, "St Jago! St Jago! the victory is ours, the enemy is defeated;" ſoon after which he was thrown from his horſe, and trampled to death.

Spaniards defeated with great ſlaughter.

Haſſan having had the misfortune to diſoblige his ſubjects by allowing the mountaineers of Cuco to buy ammunition at Algiers, was ſent in irons to Conſtantinople, while the aga of the janizaries, and general of the land forces, ſupplied his place. Haſſan eaſily found means to clear himſelf; but a new baſhaw was appointed, called Achmet; who had no ſooner arrived than he ſent the two deputy-baſhaws to Conſtantinople, where their heads were ſtruck off.—Achmet was a man of ſuch inſatiable avarice, that, upon his arrival at Algiers, all ranks of people came in ſhoals to make him preſents; which he the more greedily accepted, as he had bought his dignity by the money he had amaſſed while head gardener to the Sultan. He enjoyed it, however, only four months; and after his death, the ſtate was governed other four months by his lieutenant: when Haſſan was a third time ſent viceroy to Algiers, where he was received with the greateſt demonſtrations of joy.

Haſſan ſent in irons to Conſtantinople.

Reinſtated.

Siege of Marſalquiver.

The firſt enterpriſe in which Haſſan engaged, was the ſiege of Marſalquiver, ſituated near the city Oran, which he deſigned to inveſt immediately after. The army employed in this ſiege conſiſted of 26,000 foot and 10,000 horſe, beſides which he had a fleet conſiſting of 32 galleys and galliots, together with three French veſſels laden with biſcuit, oil, and other proviſions. The city was defended by Don Martin de Cordova, brother of the count d'Alcandela, who had been taken priſoner in the battle where that nobleman was killed, but had obtained his liberty from the Algerines with immenſe ſums, and now made a moſt gallant defence againſt the Turks. The city was attacked with the utmoſt fury by ſea and land, ſo that ſeveral breaches were made in the walls. The Turkiſh ſtandards were ſeveral times planted on the walls, and as often diſlodged; but the place muſt have in the end ſubmitted, had not Haſſan been obliged to raiſe the ſiege in haſte, on the news that the famed Genoeſe admiral Doria was approaching with conſiderable ſuccours from Italy. The fleet accordingly arrived ſoon after; but miſſing the Algerine galleys, bore away for Pennon de Velez, where they were ſhamefully repulſed by a handful of Turks who garriſoned that place; which, however, was taken the following year.

Haſſan again recalled.

In 1567, Haſſan was again recalled to Conſtantinople, where he died three years after. He was ſucceeded by Mahomet, who gained the love of the Algerines by ſeveral public-ſpirited actions. He incorporated the janizaries and Levantine Turks together, and by that means put an end to their diſſenſions, which laid

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laid the foundation of the Algerine independency on the Porte. He likewife added fome confiderable fortifications to the city and caftle, which he defigned to render impregnable. But while he was thus ftudying the intereft of Algiers, one John Gafcon, a bold Spanifh adventurer, formed a defign of furprifing the whole piratic navy in the bay, and fetting them on fire in the night-time, when they lay defencelefs, and in their firft fleep. For this he had not only the permiffion of King Philip II. but was furnifhed by him with proper veffels, mariners, and fireworks, for the execution of his plot. With thefe he fet fail for Algiers in the moft proper feafon, viz. the beginning of October, when moft, if not all the fhips lay at anchor there; and eafily failed near enough, unfufpected, to view their manner of riding, in order to catch them unawares, at a time when the greater part of their crews were difperfed in their quarters. He came accordingly, unperceived by any, to the very mole-gate, and difperfed his men with their fire-works; but to their great furprife, they found them fo ill mixed, that they could not with all their art make them take fire. In the mean time, Gafcon took it into his head, by way of bravado, to go to the mole-gate, and give three loud knocks at it with the pommel of his dagger, and to leave it fixed in the gate by its point, that the Algerines might have caufe to remember him. This he had the good fortune to do without meeting with any difturbance or oppofition: but it was not fo with his men; for no fooner did they find their endeavours unfuccefsful, than they made fuch a buftle as quickly alarmed the guard pofted on the adjacent baftion, from which the uproar quickly fpread itfelf through the whole garrifon. Gafcon now finding himfelf in the utmoft danger, failed away with all poffible hafte: but he was purfued, overtaken, and brought back a prifoner to Mahomet; who no fooner got him into his power, than he immediately caufed a gibbet of confiderable height to be erected on the fpot where Gafcon had landed, ordering him to be hoifted up, and hung by the feet to a hook, that he might die in exquifite torture; and to fhow his refentment and contempt of the king his mafter, he ordered his commiffion to be tied to his toes. He had not, however, hung long in that ftate, when the captain who took him, accompanied by a number of other corfairs, interceded fo ftrongly in his behalf, that he was taken down, and put under the care of fome Chriftian furgeons; but two days after, fome Moors reporting that it was the common talk and belief in Spain, that the Algerines durft not hurt a hair of Gafcon's head, &c. the unfortunate Spaniard was hoifted up by a pulley to the top of the execution-wall, and let down again upon the hook, which in his fall catched him by the belly, and gave him fuch a wound, that he expired without a groan.—Thus ended the expedition of John Gafcon, which has procured him a place among the Spanifh martyrs; while, on the other hand, the Algerines look upon his difappointment to have been miraculous, and owing to the efficacious protection of the powerful faint *Sidi Outededda*, whofe prayers had before raifed fuch a terrible ftorm againft the Spanifh fleet.

John Gafcon's bold attempt to fire the Algerine fleet.

His bravado at the city gate.

Is taken and put to death.

Mahomet, being foon after recalled, was fucceeded by the famous renegado Ochali, who reduced the kingdom of Tunis; which, however, remained fubject to the viceroy of Algiers only till the year 1586, when a bafhaw of Tunis was appointed by the Porte.

Algiers.

The kingdom of Algiers continued to be governed, till the beginning of the feventeenth century, by viceroys or bafhaws appointed by the Porte; concerning whom we find nothing very remarkable, further than that their avarice and tyranny were intolerable both to the Algerines and the Turks themfelves. At laft the Turkifh janizaries and militia becoming powerful enough to fupprefs the tyrannic fway of thefe bafhaws, and the people being almoft exhaufted by the heavy taxes laid upon them, the former refolved to depofe thefe petty tyrants, and fet up fome officers of their own at the head of the realm. The better to fucceed in this attempt, the militia fent a deputation of fome of their chief members to the Porte, to complain of the avarice and oppreffion of thefe bafhaws, who funk both the revenue of the ftate, and the money remitted to it from Conftantinople, into their own coffers, which fhould have been employed in keeping up and paying the foldiery; by which means they were in continual danger of being overpowered by the Arabians and Moors, who, if ever fo little affifted by any Chriftian power, would hardly fail of driving all the Turks out of the kingdom. They reprefented to the Grand Vizier how much more honourable, as well as eafier and cheaper, it would be for the Grand Signior to permit them to choofe their own dey, or governor, from among themfelves, whofe intereft it would then be to fee that the revenue of the kingdom was rightly applied in keeping up its forces complete, and in fupplying all other exigencies of the ftate, without any farther charge or trouble to the Porte than that of allowing them its protection. On their part, they engaged always to acknowledge the Grand Signiors as their fovereigns, and to pay them their ufual allegiance and tribute, to refpect their bafhaws, and even to lodge and maintain them and their retinue, in a manner fuitable to their dignity, at their own charge. The bafhaws, however, were, for the future, to be excluded from affifting at any but general douwans, unlefs invited to it; and from having the liberty of voting in them, unlefs when their advice was afked, or the intereft of the Porte was likely to fuffer by their filence. All other concerns, which related to the government of Algiers, were to be wholly left under the direction of the dey and his douwan.

Thefe propofals having been accepted by the Porte, the deputies returned highly fatisfied; and having notified their new privileges, the great *douwan* immediately proceeded to the election of a dey from among themfelves. They compiled a new fet of laws, and made feveral regulations for the better fupport and maintenance of this new form of government, to the obfervation of which they obliged all their fubjects to fwear; and the militia, navy, commerce, &c. were all fettled pretty nearly on the footing upon which they now are, and which fhall be afterwards defcribed; though the fubfequent altercations that frequently happened between the bafhaws and deys, the one endeavouring to recover their former power, and the other to curtail it, caufed fuch frequent complaints and difcontents at the Ottoman court, as made them frequently repent their compliance.

Algerines allowed to choofe their own deys.

In

Algiers.

In the year 1601, the Spaniards, under the command of Doria the Genoese admiral, made another attempt upon Algiers, in which they were more fortunate than usual, their fleet being only driven back by contrary winds, so that they came off without loss. In 1609, the Moors being expelled from Spain, flocked in great numbers to Algiers; and as many of them were very able sailors, they undoubtedly contributed to make the Algerine fleet so formidable as it became soon after; though it is probable the frequent attempts made on their city would also induce them to increase their fleet. In 1616, their fleet consisted of 40 sail of ships between 200 and 400 tons, their admiral 500 tons. It was divided into two squadrons, one of 18 sail, before the port of Malaga; and the other at the cape of Santa Maria, between Lisbon and Seville; both of which attacked all Christian ships, both English and French, with whom they pretended to be in friendship, as well as Spaniards and Portuguese, with whom they were at war.

Become formidable to the Europeans.

The Algerines were now become very formidable to the European powers. The Spaniards, who were most in danger, and least able to cope with them, solicited the assistance of England, the pope, and other states. The French, however, were the first who dared to show their resentment of the perfidious behaviour of these miscreants; and in 1617, M. Beaulieu was sent against them with a fleet of 50 men of war, who defeated their fleet, took two of their vessels, while their admiral sunk his own ship and crew, rather than fall into his enemies hands.

An English squadron sent against the Algerines.

In 1620, a squadron of English men of war was sent against Algiers, under the conduct of Sir Robert Mansel; but of this expedition we have no other account, than that it returned without doing any thing; and the Algerines, becoming more and more insolent, openly defied all the European powers, the Dutch only excepted; to whom, in 1625, they sent a proposal directed to the prince of Orange, that in case they would fit out 20 sail of ships the following year, upon any good service against the Spaniards, they would join them with 60 sail of their own.

The next year, the *Coulolies*, or *Cologlies* (the children of such Turks as had been permitted to marry at Algiers), who were enrolled in the militia, having seized on the citadel, had well nigh made themselves masters of the city; but were attacked by the Turks and renegadoes, who defeated them with terrible slaughter. Many of them were put to death; and their heads thrown in heaps upon the city-walls, without the eastern gate. Part of the citadel was blown up; and the remaining Coulolies were dismissed from the militia, to which they were not again admitted till long after.

States of Barbary throw off their dependence on the Porte.

In 1623, the Algerines and other states of Barbary threw off their dependence on the Porte altogether, and set up for themselves. What gave occasion to this was the 25 years truce which Sultan Amurath IV. was obliged to make with the emperor Ferdinand II. to prevent his being overmatched by carrying on a war against him and the sophi of Persia at the same time. As this put a stop to the piratical trade of the Algerines, they proceeded as above mentioned; and resolved, that whoever desired to be at peace with them, must, distinctly and separately, apply to their government.—No sooner was this resolution taken, than the Algerines began to make prizes of several merchant ships belonging to powers at peace with the Porte. Nay, having seized a Dutch ship and poleacre at Scanderoon, they ventured on shore; and finding the town abandoned by the Turkish aga and inhabitants, they plundered all the magazines and warehouses, and set them on fire.—About this time Louis XIII. undertook to build a fort on their coasts, instead of one formerly built by the Marsilians, and which they had demolished. This, after some difficulty, he accomplished; and it was called the *Bastion of France*: but the situation being afterwards found inconvenient, the French purchased the port of La Calle, and obtained liberty to trade with the Arabians and Moors. The Ottoman court, in the mean time, was so much embarrassed with the Persian war, that there was no leisure to check the Algerine piracies. This gave an opportunity to the vizier and other courtiers to compound matters with the Algerines, and to get a share of their prizes, which were very considerable. However, for form's sake, a severe reprimand, accompanied with threats, was sent them; to which they replied, that "these depredations deserved to be indulged to them, seeing they were the only bulwark against the Christian powers, especially against the Spaniards, the sworn enemies of the Moslem name;" adding, that "if they should pay a punctilious regard to all that could purchase peace, or liberty to trade with the Ottoman empire, they would have nothing to do but set fire to all their shipping, and turn camel-drivers for a livelihood."

Desperate undertaking of four younger brothers.

In the year 1635, four younger brothers of a good family in France entered into an undertaking so desperate, that perhaps the annals of knight-errantry can scarce furnish its equal.—This was no less than to retort the piracies of the Algerines upon themselves; and as they indiscriminately took the ships of all nations, so were these heroes indiscriminately to take the ships belonging to Algiers; and this with a small frigate of ten guns!—In this ridiculous undertaking, 100 volunteers embarked; a Maltese commission was procured, together with an able master, and 36 mariners.—They had the good fortune, on their first setting out, to take a ship laden with wine, on the Spanish coast: with which they were so much elated, that three days after they madly encountered two large Algerine corsairs, one of 20 and the other of 24 guns, both well manned, and commanded by able officers. These two large vessels having got the small frigate between them, plied her furiously with great shot, which soon took off her main-mast: notwithstanding which, the French made so desperate a resistance, that the pirates were not able to take them, till the noise of their fire brought up five more Algerines; when the French vessel, being almost torn to pieces, was boarded and taken. The young knights-errant were punished for their temerity by a dreadful captivity, from which they redeemed themselves in 1642 at the price of 6000 dollars.

A French admiral carries off the Turkish bashaw.

The Algerines prosecuted their piracies with impunity, to the terror and disgrace of the Europeans, till the year 1652; when a French fleet being accidentally driven to Algiers, the admiral took it into his head to demand a release of all the captives of his nation, without exception. This being refused, the Frenchman without ceremony carried off the Turkish viceroy,

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roy, and his cadi or judge, who had juſt arrived from the Porte, with all their equipage and retinue. The Algerines, by way of repriſal, ſurpriſed the Baſtion of France already mentioned, and carried off the inhabitants to the number of 600, with all their effects; which ſo provoked the admiral, that he ſent them word that he would pay them another viſit the next year with his whole fleet.

The Algerines fit out a formidable fleet,

The Algerines, undiſmayed by the threats of the French admiral, fitted out a fleet of 16 galleys and galliots, excellently manned and equipped, under the command of Admiral Hali Pinchinin.—The chief deſign of this armament was againſt the treaſure of Loretto; which, however, they were prevented by contrary winds from obtaining. Upon this they made a deſcent on Puglia in the kingdom of Naples; where they ravaged the whole territory of Necotra, carrying off a vaſt number of captives, and among them ſome nuns. From thence ſteering towards Dalmatia, they ſcoured the Adriatic; and loading themſelves with immenſe plunder, left thoſe coaſts in the utmoſt conſternation and reſentment.

which is totally deſtroyed by the Venetians.

At laſt the Venetians, alarmed at ſuch terrible depredations, equipped a fleet of 28 ſail, under the command of Admiral Capello, with expreſs orders to burn, ſink, or take, all the Barbary corſairs he met with, either on the open ſeas, or even in the Grand Signior's harbours, purſuant to a late treaty of peace with the Porte. On the other hand, the captain baſhaw, who had been ſent out with the Turkiſh fleet to chaſe the Florentine and Malteſe cruiſers out of the Archipelago, underſtanding that the Algerine ſquadron was ſo near, ſent expreſs orders to the admiral to come to his aſſiſtance. Pinchinin readily agreed; but having firſt reſolved on a deſcent upon the iſland of Liſſa, or Liſina, belonging to the Venetians, he was overtaken by Capello, from whom he retired to Valona, a ſea port belonging to the Grand Signior, whither the Venetian admiral purſued him; but the Turkiſh governor refuſing to eject the pirates according to the articles of the peace between the Ottoman court and Venice, Capello was obliged to content himſelf with watching them for ſome time. Pinchinin was ſoon weary of reſtraint, and ventured out; when an engagement immediately enſued, in which the Algerines were defeated, and five of their veſſels diſabled, with the loſs of 1500 men, Turks, and Chriſtian ſlaves; beſides 1600 galley ſlaves who regained their liberty. Pinchinin, after this defeat, returned to Valona, where he was again watched by Capello; but the latter had not lain long at his old anchorage before he received a letter from the ſenate, deſiring him to make no farther attempt on the pirates at that time, for fear of a rupture with the Porte. This was followed by a letter from the governor of Valona, deſiring him to take care leſt he incurred the ſultan's diſpleaſure by ſuch inſults. The brave Venetian was forced to comply; but reſolving to take ſuch a leave of the Algerines as he thought they deſerved, obſerved how they had reared their tents, and drawn their booty and equipage along the ſhore. He then kept firing among their tents, while ſome well manned galliots and brigantines were ordered among their ſhipping, who attacked them with ſuch bravery, that, without any great loſs, they towed out their 16 galleys, with all their cannon, ſtores, &c.—In this laſt engagement a ball from one of the Venetian galleys happening to ſtrike a Turkiſh moſque, the whole action was conſidered as an inſult upon the Grand Signior. To conceal this, Capello was ordered to ſink all the Algerine ſhips he had taken, except the admiral; which was to be conducted to Venice, and laid up as a trophy. Capello came off with a ſevere reprimand; but the Venetians were obliged to buy, with 500,000 ducats, a peace from the Porte. The Grand Signior offered to repair the loſs of the Algerines by building ten galleys for them, upon condition that they ſhould continue in his ſervice till the end of the enſuing ſummer; but Pinchinin, who knew how little the Algerines choſe to lie under obligations to him, civilly declined the offer.

Algiers in the utmoſt confuſion at the news,

In the mean time, the news of this defeat and loſs filled Algiers with the utmoſt grief and confuſion. The whole city was on the point of a general inſurrection, when the baſhaw and douwan iſſued a proclamation, forbidding not only complaints and outcries, under the ſevereſt penalties; but all perſons whatever to *take their thumbs from within their girdles*, while they were deliberating on this important point. In the mean time they applied to the Porte for an order, that the Venetians ſettled in the Levant ſhould make up their loſs. But with this the Grand Signior refuſed to comply, and left them to repair their loſſes, as well as build new ſhips in the beſt manner they could. It was not long, however, before they had the ſatisfaction to ſee one of their corſairs land, with a freſh ſupply of 600 ſlaves, whom he had brought from the coaſt of Iceland, whither he had been directed by a miſcreant native taken on board a Daniſh ſhip.

They ſet out a new fleet.

Our pirates did not long continue in their weak and defenceleſs ſtate; being able, at the end of two years, to appear at ſea with a fleet of 65 ſail. The admiral Pinchinin equipped four galliots at his own expence; with which, in conjunction with the Chiayah, or ſecretary of the baſhaw of Tripoli, he made a ſecond excurſion. This ſmall ſquadron, conſiſting of five galleys and two brigantines, fell in with an Engliſh ſhip of 40 guns; which, however, Pinchinin's captains refuſed to engage; but being afterwards reproached by him for their cowardice, they ſwore to attack the next Chriſtian ſhip which came in their way. This happened to be a Dutch merchantman, of 28 guns, which was deeply laden, and unable to uſe her ſails by reaſon of a calm. Pinchinin immediately ſummoned her to ſurrender; but receiving an ironical anſwer, drew up his ſquadron in form of a half moon, that they might pour their ſhot all at once into their adverſary. This, however, the Dutchman avoided, by means of a breeze of wind which fortunately ſprung up and enabled him to turn his ſhip; upon which the galleys ran foul of each other. Upon this, Pinchinin ran his own galley along ſide of the merchantman, the upper deck of which 70 Algerines immediately took poſſeſſion of, ſome of them cutting the rigging, and others plying the hatches with hand grenadoes: but the Dutchmen having ſecured themſelves in their cloſe quarters, began to fire at the Algerines on board, from two pieces of cannon loaded with ſmall ſhot; by which they were all ſoon killed, or forced to ſubmit. Pinchinin, in the mean time, made ſeveral unſucceſsful attempts to relieve his men, as well as to ſurround the Dutchman with his other galleys: but that ſhip lay ſo deep in the water,

Five of their galleys defeated by a Dutch merchantman.

Algiers. water, that every ſhot did terrible execution among the pirates; ſo that they were obliged to remove farther off. At laſt the Dutch captain, having ordered his guns to be loaded with cartouches, gave them ſuch a parting volley as killed 200 of them, and ſent the reſt back to Algiers in a moſt diſmal plight.

But though Pinchinin thus returned in diſgrace, the reſt of the fleet quickly came back with vaſt numbers of ſlaves, and an immenſe quantity of rich ſpoils; inſomuch that the Engliſh, French, and Dutch, were obliged to cringe to the mighty Algerines, who ſometimes vouchſafed to be at peace with them, but ſwore eternal war againſt Spain, Portugal, and Italy, whom they looked upon as the greateſt enemies to the Mahometan name.

Preparations againſt Algiers by Louis XIV.

At laſt Louis XIV. provoked by the grievous outrages committed by the Algerines on the coaſts of Provence and Languedoc, ordered, in 1681, a conſiderable fleet to be fitted out againſt them, under the marquis du Queſne, vice-admiral of France. His firſt expedition was againſt a number of Tripolitan corſairs; who had the good fortune to outrow him, and ſhelter themſelves in the iſland of Scio belonging to the Turks. This did not, however, prevent him from purſuing them thither, and making ſuch terrible fire upon them as quickly deſtroyed 14 of their veſſels, beſides battering the walls of the caſtle.

Algiers bombarded and ſet on fire by the French.

This ſeverity ſeemed only to be deſigned as a check to the piracies of the Algerines; but, finding they ſtill continued their outrages on the French coaſt, he ſailed to Algiers in Auguſt 1682, cannonading and bombarding it ſo furiouſly, that the whole town was in flames in a very little time. The great moſque was battered down, and moſt of the houſes laid in ruins, inſomuch that the inhabitants were on the point of abandoning the place; when on a ſudden the wind turned about, and obliged Du Queſne to return to Toulon.

Algerines commit dreadful ravages in France.

The Algerines immediately made repriſals, by ſending a number of galleys and galliots to the coaſt of Provence, where they committed the moſt dreadful ravages, and brought away a vaſt number of captives: upon which a new armament was ordered to be got ready at Toulon and Marſeilles againſt the next year; and the Algerines, having received timely notice, put themſelves into as good a ſtate of defence as the time would allow.

The city again bombarded.

In May 1683, Du Queſne with his ſquadron caſt anchor before Algiers; where being joined by the Marquis d'Affranville at the head of five ſtout veſſels, it was reſolved to bombard the town next day. Accordingly 100 bombs were thrown into it the firſt day, which did terrible execution; while the beſieged made ſome hundred diſcharges of their cannon againſt them without doing any conſiderable damage. The following nights the bombs were again thrown into the city in ſuch numbers, that the dey's palace and other great edifices were almoſt deſtroyed; ſome of their batteries were diſmounted, and ſeveral veſſels ſunk in the port. The dey and Turkiſh baſhaw, as well as the whole ſoldiery, alarmed at this dreadful havock, immediately ſued for peace. As a preliminary, the immediate ſurrender was inſiſted on of all Chriſtian captives who had been taken fighting under the French flag; which being granted, 142 of them were immediately delivered up, with a promiſe of ſending him the remainder as ſoon as they could be got from the different parts of the country. Accordingly Du Queſne ſent his commiſſary-general and one of his engineers into the town; but with expreſs orders to inſiſt upon the delivery of all the French captives without exception, together with the effects they had taken from the French: and that Mezomorto their then admiral, and Hali Rais one of their captains ſhould be given as hoſtages. Algiers.

This laſt demand having embarraſſed the dey, he aſſembled the douwan, and acquainted them with it; upon which Mezomorto fell into a violent paſſion, and told the aſſembly, that the cowardice of thoſe who ſat at the helm had occaſioned the ruin of Algiers: but that, for his part, he would never conſent to deliver up any thing that had been taken from the French. He immediately acquainted the ſoldiery with what had paſſed; which ſo exaſperated them, that they murdered the dey that very night, and on the morrow choſe Mezomorto in his place. This was no ſooner done, than he cancelled all the articles of peace which had been made, and hoſtilities were renewed with greater fury than ever.

Set on fire and almoſt deſtroyed.

The French admiral now kept pouring in ſuch volleys of bombs, that in leſs than three days the greateſt part of the city was reduced to aſhes; and the fire burnt with ſuch vehemence, that the ſea was enlightened with it for more than two leagues round. Mezomorto, unmoved at all theſe diſaſters, and the vaſt number of the ſlain, whoſe blood ran in rivulets along the ſtreets; or rather, growing furious and deſperate, ſought only how to wreak his revenge on the enemy; and, not content with cauſing all the French in the city to be cruelly murdered, ordered their conſul to be tied hand and foot, and faſtened alive to the mouth of a mortar, from whence he was ſhot away againſt their navy.—By this piece of inhumanity Du Queſne was ſo exaſperated, that he did not leave Algiers till he had utterly deſtroyed all their fortifications, ſhipping, almoſt all the lower part, and above two-thirds of the upper part of the city, by which means it became little elſe than a heap of ruins.

Algerines ſue for peace.

The haughty Algerines were now thoroughly convinced that they were not invincible; and therefore immediately ſent an embaſſy into France, begging in the moſt abject terms for peace; which Louis immediately granted, to their inexpreſſible joy. They now began to pay ſome regard to other nations, and to be a little cautious how they wantonly incurred their diſpleaſure. The firſt bombardment by the French had ſo far humbled the Algerines, that they condeſcended to enter into a treaty with England; which was renewed upon terms very advantageous to the latter in 1686. It is not to be ſuppoſed, however, that the natural perfidy of the Algerines would diſappear on a ſudden: notwithſtanding this treaty, therefore, they loſt no opportunity of making prizes of the Engliſh ſhips when they could conveniently come at them.

Seven of their ſhips burnt by Captain Beach.

Upon ſome infringement of this kind, Captain Beach drove aſhore and burnt ſeven of their frigates in 1695; which produced a renewal of the treaty five years after: but it was not till the taking of Gibraltar and Port Mahon, that Britain could have a ſufficient check upon them to enforce the obſervation of treaties; and theſe have ſince proved ſuch reſtraints upon Algiers, that they ſtill continue to pay a greater deference to the Engliſh than to any other European power.

The

Algiers.

Expulsion of the Turkish bashaw.

The present century furnishes no very remarkable events with regard to Algiers, except the taking of the famed city of Oran from the Spaniards in 1708 (which however they regained in 1737), and the expulsion of the Turkish bashaw, and uniting his office to that of dey in 1710. This introduced the form of government which still continues in Algiers.

Revenues, &c. of the dey.

The dey is now absolute monarch; and pays no other revenue to the Porte than that of a certain number of fine boys or youths, and some other presents which are sent thither yearly. His own income probably rises and falls according to the opportunities he has of fleecing both natives and foreigners; whence it is variously computed by different authors. Dr Shaw computes the taxes of the whole kingdom to bring into the treasury no more than 300,000 dollars; but supposes that the eighth part of the prizes, the effects of those persons who die without children, joined to the yearly contributions raised by the government, presents from foreigners, fines and oppressions, may bring in about as much more. Both the dey and officers under him enrich themselves by the same laudable methods of rapine and fraud; which it is no wonder to find the common people practising upon one another, and especially upon strangers, seeing they themselves are impoverished by heavy taxes and the injustice of those who are in authority.

We have already hinted, that the first deys were elected by the militia, who were then called the *douwan* or common council. This elective body was at first composed of 800 militia officers, without whose consent the dey could do nothing; and upon some urgent occasions all the officers residing in Algiers, amounting to above 1500, were summoned to assist. But since the deys, who may be compared to the Dutch stadtholders, have become more powerful, the douwan is principally composed of 30 chiah bashaws or colonels, with now and then the mufti and cadi upon some emergencies; and on the election of a dey, the whole soldiery are allowed to come and give their votes. All the regulations of state ought to be determined by that assembly, before they pass into a law, or the dey hath power to put them in execution: but, for many years back, the douwan has been of so little account, that it is only convened out of formality, and to give assent to what the dey and his chief favourites have concerted beforehand. The method of gathering the votes in this august assembly is perfectly agreeable to the character of those who compose it. The aga, or general of the janizaries, or the president *pro tempore*, first proposes the question; which is immediately repeated with a loud voice by the chiah bashaws, and from them echoed again by officers called *bashaldalas*; from these the question is repeated from one member of the douwan to another, with strange contortions, and the most hideous growlings, if it is not to their liking. From the loudness of this growling noise, the aga is left to guess as well as he can whether the majority of the assembly are pleased or displeased with the question; and from such a preposterous method, it is not surprising that these assemblies should seldom end without some tumult or disorder. As the whole body of the militia is concerned in the election of a new dey, it is seldom carried on without blows and bloodshed: but when once the choice is made, the person elected is saluted with the words Alla Barick, "God bless you, and prosper you;" and the new dey usually causes all the officers of the douwan who had opposed his election to be strangled, filling up their places with those who had been most zealous in promoting it. From this account of the election of the deys, it cannot be expected that their government should be at all secure; and as they arrive at the throne by tumult, disorder, and bloodshed, they are generally deprived of it by the same means, scarcely one in ten of them having the good fortune to die a natural death.

Strange method of gathering the votes of the douwan.

In this country it is not to be expected that justice will be administered with any degree of impartiality. The Mahometan soldiery, in particular, are so much favoured, that they are seldom put to death for any crime except rebellion: in which case they are either strangled with a bow string or hanged to an iron hook. In lesser offences, they are fined, or their pay stopped; and if officers, they are reduced to the station of common soldiers, from whence they may gradually raise themselves to their former dignity. Women guilty of adultery, have a halter tied about their necks, with the other end fastened to a pole, by which they are held under water till they are suffocated. The bastinado is likewise inflicted for small offences; and is given either upon the belly, back, or soles of the feet, according to the pleasure of the cadi; who also appoints the number of strokes. These sometimes amount to 200 or 300, according to the indulgence the offender can obtain either by bribery or friends; and hence he often dies under this punishment for want of powerful enough advocates. But the most terrible punishments are those inflicted upon the Jews or Christians who speak against Mahomet or his religion; in which case, they must either turn Mahometans or be impaled alive. If they afterwards apostatize, they are burned or roasted alive, or else thrown down from the top of the city walls, upon iron hooks, where they are caught by different parts of their body according as they happen to fall, and sometimes expire in the greatest torments; though by accident they may be put out of pain at once, as we have already related of the Spanish adventurer John Gascon. This terrible punishment, however, begins now to be disused.

Punishments, &c.

The officer next in power to the dey is the aga of the janizaries, who is one of the oldest officers in the army, and holds his post only for two months. He is then succeeded by the chiah, or next senior officer.—During the two months in which the aga enjoys his dignity, the keys of the metropolis are in his hands; all military orders are issued out in his name; and the sentence of the dey upon any offending soldier, whether capital or not, can only be executed in the court of his palace.—As soon as he has gone through this short office, he is considered as *mazoul*, or superannuated; receives his pay regularly, like the rest of the militia, every two moons; is exempt from all further duties, except when called by the dey to assist at the grand council, to which he hath, however, a right to come at all times, but hath no longer a vote in it. Next to the aga in dignity is the secretary of state, who registers all the public acts; and after him are the 30 chiahs or colonels, who sit next to the aga in the douwan, and in the same gallery with him. Out of this class are generally chosen those who go ambassadors to foreign

Aga of the janizaries and other military officers.

Algiers.

reign courts, or who disperse the dey's orders throughout the realm. Next to them are 800 bolluck bashaws or eldest captains, who are promoted to that of chiah bashaws according to their seniority. The oldack bashaws or lieutenants are next; who amount to 400, and are regularly raised to the rank of captains in their turn, and to other employments in the state, according to their abilities. These, by way of distinction, wear a leather strap, hanging down to the middle of their back. One rule is strictly observed in the rotation of these troops from one deputy to a higher, *viz.* the right of seniority; one single infringement of which would cause an insurrection, and probably cost the dey his life. Other military officers of note are the vekelards or purveyors of the army; the peys, who are the four oldest soldiers, and consequently the nearest to preferment; the foulacks, who are the next in seniority to them, and are part of the dey's body-guard, always marching before him when he takes the field, and distinguished by their carabines and gilt scimitars, with a brass gun on their caps; the kayts or Turkish soldiers, each band of whom has the government of one or more adowars or itinerant villages, and collect their taxes for the dey; and the sagiards or Turkish lancemen, 100 of whom always attend the army, and watch over the water appointed for it. To these we may add the beys, or governors of the three great provinces of the realm. All the above-mentioned officers ought to compose the great douwan or council above mentioned; but only the 30 chiah bashaws have a right to sit in the gallery next after the dey; the rest are obliged to stand on the floor of the hall or council chamber, with their arms across, and as much as possible without motion; neither are they permitted to enter with their swords on, for fear of a tumult. As for those who have any matters to transact with the douwan, they must stand without, let the weather be ever so bad; and there they are commonly presented with coffee by some of the inferior officers, till they are dismissed.

Account of the corsairs, commerce, &c.

It does not appear that the Algerines avail themselves of the benefit of their internal resources to the extent they might do; for their genius leads them too much to the piratical trade to mind any real advantage that might be derived from their own country. The corsairs or pirates form each a small republic, of which the rais or captain is the supreme bashaw; who, with the officers under him, form a kind of douwan, in which every matter relating to the vessel is decided in an arbitrary way. These corsairs are chiefly instrumental in importing whatever commodities are brought into the kingdom either by way of merchandise or prizes. These consist chiefly of gold and silver stuffs, damasks, cloths, spices, tin, iron, plated brass, lead, quicksilver, cordage, sail-cloth, bullets, cochineal, linen, tartar, alum, rice, sugar, soap, cotton raw and spun, copperas, aloes, brazil and logwood, vermilion, &c. Very few commodities, however, are exported from this part of the world: the oil, wax, hides, pulse, and corn produced, being but barely sufficient to supply the country; though before the loss of Oran the merchants have been known to ship off from one or other of the ports of Barbary several thousand tons of corn. The consumption of oil, though here in great abundance, is likewise so considerable in this kingdom, that it is seldom permitted to be shipped off for Europe. The other exports consist chiefly in ostriches feathers, copper, rugs, silk sashes, embroidered handkerchiefs, dates, and Christian slaves. Some manufactures in silk, cotton, wool, leather, &c. are carried on in this country, but mostly by the Spaniards settled here, especially about the metropolis. Carpets are also a manufacture of the country; which, though much inferior to those of Turkey both in beauty and fineness, are preferred by the people to lie upon on account of their being both cheaper and softer. There are also at Algiers looms for velvet, taffetas, and other wrought silks; and a coarse sort of linen is likewise made in most parts of the kingdom. The country furnishes no materials for ship-building. They have neither ropes, tar, sails, anchors, nor even iron. When they can procure enough of new wood to form the main timbers of a ship, they supply the rest from the materials of prizes which they have made; and thus find the secret of producing new and swift-sailing vessels from the ruins of the old. Of all the states on the coast of Barbary, the Algerines are the strongest at sea.

Religion.

The religion of the Algerines is chiefly distinguished from that of the Turks by a greater variety of superstitious rites. The Koran is their acknowledged rule of faith and practice; but they are not very scrupulous in the observance of it. The mufti, or high-priest; the cadi, or chief judge; and the grand marabout, are the three principal officers who preside in matters of religion. The cadi attends in the court of justice once or twice every day, to hear and determine causes; but those of superior importance are submitted to the dey himself, or, in his absence, to one of the principal officers of the regency, who sits in the gate of the palace for that express purpose. Of this custom some traces are found in sacred history, Deut. xx. 11. 15. xxv. 7.

Algiers, a city, the capital of the above kingdom, is probably the ancient *Icosium:* by the Arabians called *Algezair*, or rather *Al-Jezier*, or *Al-Jezerah*, i. e. *the island*, because there was an island before the city, to which it has since been joined by a mole. It is built on the declivity of a hill by the sea side, in the form of an amphitheatre: at sea, it looks like the top-sail of a ship. The tops of the houses are quite flat and white, and have all the appearance of a bleachfield. One house rises above another in such a manner that they do not hinder each other's prospect. The streets are so narrow, that they will scarcely admit two persons to walk abreast, and the middle part is lower than the sides. When any loaded beasts, such as camels, horses, mules, or asses, pass along, you are forced to stand up close to the wall to let them pass by. There is but one broad street, which runs through the city from east to west, in which are the shops of the principal merchants, and the market for corn and other commodities. The lower part of the walls of the city is of hewn stone, and the upper part of brick; they are 30 feet high on the land side, and 40 towards the sea; the fosses or ditches are 20 feet broad and 7 deep. There is no sweet water in the city; and though there is a tank or cistern in every house, yet they often want water, because it rains but seldom: the chief supply is from a spring on a hill, the water of which is conveyed

conveyed by pipes to above a hundred fountains, at which a bowl is fastened for the use of passengers. The common reservoir is at the end of the mole, where the ships take in their water. Every one takes his turn at these places, except the Turks, who are first, and the Jews last. There are five gates, which are open from sun-rising till sun-setting; and seven forts or castles without the walls, the greatest of which is on the mole without the gate, all of which are well supplied with great guns. There are 10 large mosques and 50 small ones; three great colleges or public schools, and a great number of petty ones for children. The houses are square, and built of stone and brick, with a square court in the middle, and galleries all around. There are said to be about 100,000 inhabitants in the city, comprehending 5000 Jewish families, besides Christians. There are four fundics or public inns, such as are in Turkey; and six cazernes, or barracks, for the unmarried Turkish soldiers, which will hold 600 each. There are no inns for Christians to lodge at; but only a few tippling huts kept by slaves, for the accommodation of Greeks and the poorer sort of travellers, where any thing may be had for money. Here are bagnios or public baths, in the same manner as in Turkey, at a very moderate rate. The women have baths of their own, where the men dare not come. Without the city there is a great number of sepulchres, as also cells or chapels, dedicated to marabouts or reputed saints, which the women visit every Friday. The Turkish soldiers are great tyrants; for they not only turn others out of the way in the streets, but will go to the farm-houses in the country for 20 days together, living at free quarters, and making use of every thing, not excepting the women. The Algerines eat, as in Turkey, sitting cross-legged round a table about four inches high, and use neither knives nor forks. Before they begin, every one says *Be isme Allah*, "In the name of God." When they have done, a slave pours water on all their hands as they sit, and then they wash their mouths. Their drink is water, sherbet, and coffee. Wine is not allowed, though drank immoderately by some. The prospect of the country and sea from Algiers is very beautiful, it being built on the declivity of a mountain; but the city, though for several ages it has braved some of the greatest powers in Christendom, it is said, could make but a faint defence against a regular siege; and that three English fifty-gun ships might batter it about the ears of its inhabitants from the harbour. If so, the Spaniards must have been very deficient either in courage or conduct. They attacked it in the year 1775, by land and by sea, but were repulsed with great loss; though they had near 20,000 foot and 2000 horse, and 47 king's ships of different rates and 346 transports. In the years 1783 and 1784, they also renewed their attacks by sea to destroy the city and galleys; but after spending a quantity of ammunition, bombs, &c. were forced to retire without either its capture or extinction. The mole of the harbour is 500 paces in length, extending from the continent to a small island where there is a castle and large battery. E. Long. 2. 12. N. Lat. 36. 49.

ALGOA BAY, or *Zwart-hops*, in southern Africa, is situated in S. Lat. 33. 56. E. Long. 26. 53. and 500 miles distant from the Cape of Good Hope. Mr Barrow, who visited this place, found, in an adjoining valley, a species of antelope, called the *riet-bok*, or red-goat, previously unknown to naturalists. He also mentions that great advantages might accrue to the East India Company from the erection of an establishment at this place, for the purpose of preparing salted beef and fish, in consequence of the salt-pans, and the abundance of large bullocks in the vicinity; together with great numbers of excellent fish with which the coast abounds.

ALGOL, a fixed star of the third magnitude, called *Medusa's Head*, in the constellation Perseus. Its longitude is 21° 50′ 42″ of Taurus, and its latitude 23° 23′ 47″ north; according to Flamstead's catalogue. For an account of its changes, period, and other circumstances, see ASTRONOMY *Index*.

ALGONQUINS, a nation in North America, who formerly possessed great tracts of land along the north shore of the river St Lawrence. For a long time they had no rivals as hunters and warriors, and were long in alliance with the Iroquois; whom they agreed to protect from all invaders, and to let them have a share of their venison. The Iroquois, on the other hand, were to pay a tribute to their allies, out of the culture of the earth; and to perform for them all the menial duties, such as flaying the game, curing the flesh, and dressing the skins. By degrees, however, the Iroquois associated in the hunting matches and warlike expeditions of the Algonquins; so that they soon began to fancy themselves as well qualified, either for war or hunting, as their neighbours. One winter a large detachment of both nations having gone out a hunting, and secured, as they thought, a vast quantity of game, six young Algonquins and as many Iroquois were sent out to begin the slaughter. The Algonquins, probably become a little jealous of their associates, upon seeing a few elks, desired the Iroquois to return on pretence that they would have sufficient employment in flaying the game they should kill; but after three days hunting, having killed none, the Iroquois exulted, and in a day or two privately set out to hunt for themselves. The Algonquins were so exasperated at seeing their rivals return laden with game, that they murdered all the hunters in the night time. The Iroquois dissembled their resentment; but in order to be revenged, applied themselves to study the art of war as practised among those savage nations. Being afraid of engaging with the Algonquins, at first they tried their prowess on other inferior nations, and, when they thought themselves sufficiently expert, attacked the Algonquins with such diabolical fury, as showed they could be satisfied with nothing less than the extermination of the whole race; which, had it not been for the interposition of the French they would have accomplished.—The few Algonquin nations, that are now to be seen, seem entirely ignorant of agriculture, and subsist by fishing and hunting. They allow themselves a plurality of wives; notwithstanding which, they daily decrease in populousness, few or none of their nations containing above 6000 souls, and many of them not 2000. Their language is one of the three radical ones in North America, being understood from the river St Lawrence to the Mississippi.

ALGOR, with *Physicians*, an unusual coldness in any part of the body.

ALGORITHM, an Arabic word expressive of numerical computation.

Alguazil ‖ Alhambra.

ALGUAZIL, in the *Spaniſh polity*, an officer whoſe buſineſs it is to ſee the decrees of a judge executed.

ALHAMA, a very pleaſant town of the kingdom of Granada, in Spain, ſituated in the midſt of ſome craggy mountains, about 25 miles S. W. of Granada, on the banks of the Rio Frio, in W. Long. 3. 26. N. Lat. 36. 59. and having the fineſt warm baths in all Spain. It was taken from the Moors in 1481. The inhabitants, though ſurpriſed, and the town without a garriſon, made a gallant defence: but being at length forced to ſubmit, the place was abandoned to the pillage of the Chriſtian ſoldiers, who, not ſatisfied with an immenſe quantity of gold, and jewels, made ſlaves of upwards of 3000 of the inhabitants.

ALHAMBRA, the ancient fortreſs and reſidence of the Mooriſh monarchs of Granada. It derives its name from the red colour of the materials which it was originally built with, Alhambra ſignifying a red houſe. It appears to a traveller a huge heap of as ugly buildings as can well be ſeen, all huddled together, ſeemingly without the leaſt intention of forming *one* habitation out of them. The walls are entirely unornamented, all gravel and pebbles, daubed over with plaſter by a very coarſe hand: yet this is the palace of the Mooriſh kings of Granada, indiſputably the moſt curious place within that exiſts in Spain, perhaps in the world. In many countries may be ſeen excellent modern as well as ancient architecture, both entire and in ruins; but nothing to be met with anywhere elſe can convey an idea of this edifice, except the decorations of an opera, or the tales of the genii.

Paſſing round the corner of the emperor's palace, one is admitted at a plain unornamented door in a corner. On my firſt viſit, ſays Mr Swinburne, I confeſs I was ſtruck with amazement, as I ſtept over the threſhold, to find myſelf on a ſudden tranſported into a ſpecies of fairy land. The firſt place you come to is the court called the *communa* or *del meſucar*, that is the *common baths;* an oblong ſquare, with a deep baſon of clear water in the middle; two flights of marble ſteps leading down to the bottom; on each ſide a parterre of flowers, and a row of orange trees. Round the court runs a periſtyle paved with marble; the arches bear upon very ſlight pillars, in proportions and ſtyle different from all the regular orders of architecture. The ceilings and walls are incruſtated with fretwork in ſtucco, ſo minute and intricate, that the moſt patient draughtſman would find it difficult to follow it, unleſs he made himſelf maſter of the general plan. This would facilitate the operation exceedingly; for all this work is frequently and regularly repeated at certain diſtances, and has been executed by means of ſquare moulds applied ſucceſſively, and the parts joined together with the utmoſt nicety. In every diviſion are Arabic ſentences of different lengths, moſt of them expreſſive of the following meanings: "There is no conqueror but God;" or, "Obedience and honour to our lord Abouabdoulah." The ceilings are gilt or painted; and time has cauſed no diminution in the freſhneſs of their colours, though conſtantly expoſed to the air. The lower part of the walls is moſaic, diſpoſed in fantaſtic knots and feſtoons. A work ſo novel, ſo exquiſitely finiſhed, and ſo different from all that he had ever ſeen, muſt afford a ſtranger the moſt agreeable ſenſations while he treads this magic ground. The porches at the ends are more like grotto-work than any thing elſe to which they can be compared. That on the right hand opens into an octagon vault, under the emperor's palace, and forms a perfect whiſpering gallery, meant to be a communication between the offices of both houſes.

Travels in Spain.

Oppoſite to the door of the communa through which you enter, is another leading into the *quarto de los leones*, or apartment of the lions; which is an oblong court, 100 feet in length and 50 in breadth, environed with a colonnade 7 feet broad on the ſides and 10 at the end. Two porticoes or cabinets about 15 feet ſquare, project into the court at the two extremities. The ſquare is paved with coloured tiles; the colonnade with white marble. The walls are covered five feet up from the ground with blue and yellow tiles, diſpoſed chequerwiſe. Above and below is a border of ſmall eſcutcheons, enamelled blue and gold, with an Arabic motto on a bend; ſignifying, "No conqueror but God." The columns that ſupport the roof and gallery are of white marble, very ſlender, and fantaſtically adorned. They are 9 feet high, including baſe and capital, and $8\frac{1}{2}$ inches diameter. They are very irregularly placed; ſometimes ſingly, at others in groups of three, but more frequently two together. The width of the horſe-ſhoe arches above them is four feet two inches for the large ones, and three for the ſmaller. The ceiling of the portico is finiſhed in a much finer and more complicated manner than that of the communa, and the ſtucco laid on the walls with inimitable delicacy; in the ceiling it is ſo artfully froſted and handled as to exceed belief. The capitals are of various deſigns, though each deſign is repeated ſeveral times in the circumference of the court, but not the leaſt attention has been paid to placing them regularly or oppoſite to each other. Not the ſmalleſt repreſentation of animal life can be diſcovered amidſt the varieties of foliages, groteſques, and ſtrange ornaments. About each arch is a large ſquare of arabeſques, ſurrounded with a rim of characters, that are generally quotations from the Koran. Over the pillars is another ſquare of delightful filligree work. Higher up is a wooden rim, or kind of cornice, as much enriched with carving as the ſtucco that covers the part underneath. Over this projects a roof of red tiles, the only thing that disfigures this beautiful ſquare. This ugly covering is a modern addition made by a late prime miniſter, who a few years ago gave the Alhambra a thorough repair. In Mooriſh times, the building was covered with large painted and glazed tiles, of which ſome few are ſtill to be ſeen. In the centre of the court are twelve ill-made lions muzzled, their fore parts ſmooth, their hind parts rough, which bear upon their backs an enormous baſon, out of which a leſſer riſes. While the pipes were kept in good order, a great volume of water was thrown up, that, falling down into the baſons, paſſed through the beaſts, and iſſued out of their mouths into a large reſervoir, where it communicated by channels with the jet d'eaus in the apartments. This fountain is of white marble, embelliſhed with many feſtoons and Arabic diſtichs, thus tranſlated:

"Seeſt thou not how the water flows copiouſly like the Nile?"

Alhambra.

"This resembles a sea washing over its shores, threatening shipwreck to the mariner."

"This water runs abundantly, to give drink to the lions."

"Terrible as the lion is our king in the day of battle."

"The Nile gives glory to the king, and the lofty mountains proclaim it."

"This garden is fertile in delights: God takes care that no noxious animal shall approach it."

"The fair princess that walks in this garden, covered with pearls, augments its beauty so much, that thou may'st doubt whether it be a fountain that flows, or the tears of her admirers."

Passing along the colonnade, and keeping on the south side, you come to a circular room occupied by the men as a place for drinking coffee, &c. A fountain in the middle refreshed the apartment in summer. The form of this hall, the elegance of its cupola, the cheerful distribution of light from above, and the exquisite manner in which the stucco is designed, painted, and finished, exceed all powers of description. Every thing in it inspires the most pleasing voluptuous ideas: yet in this sweet retreat they pretend that Abouabdoulah assembled the Abencerrages, and caused their heads to be struck off into the fountain. Continuing your walk round, you are next brought to a couple of rooms at the head of the court, which are supposed to have been tribunals or audience chambers.

Opposite to the *Sala de los Abencerrages* is the entrance into the *Torre de las dos hermanas*, or the tower of the two sisters; so named from two very beautiful pieces of marble laid as flags in the pavement. This gate exceeds all the rest in profusion of ornaments, and in beauty of prospect which it affords through a range of apartments, where a multitude of arches terminate in a large window open to the country. In a gleam of sunshine, the variety of tints and lights thrown upon this enfilade are uncommonly rich. The first hall is the concert-room, where the women sat; the musicians played above in four balconies. In the middle is a jet d'eau. The marble pavement is equal to the finest existing, for the size of the flags and evenness of the colour. The two sisters which give name to the room, are slabs that measure 15 feet by 7½, without flaw or stain. The walls, up to a certain height, are mosaic, and above are divided into very neat compartments of stucco, all of one design, which is also followed in many of the adjacent halls and galleries. The ceiling is a fretted cove. To preserve this vaulted roof, as well as some of the other principal cupolas, the outward walls of the towers are raised 10 feet above the top of the dome, and support another roof over all, by which means no damage can ever be caused by wet weather or excessive heat and cold. From this hall you pass round the little myrtle garden of Lindaraxa, into an additional building made to the east end by Charles V. The rooms are small and low. His dear motto, *Plus outrè*, appears on every beam. This leads to a little tower, projecting from the line of the north wall, called *el tocador*, or the dressing-room of the sultana. It is a small square cabinet, in the middle of an open gallery, from which it receives light by a door and three windows. The look-out is charming. In one corner is a large marble flag, drilled full of holes, through which the smoke of perfumes ascended from furnaces below; and here, it is presumed, the Moorish queen was wont to sit to fumigate and sweeten her person. The emperor caused this pretty room to be painted with representations of his wars, and a great variety of grotesques, which appear to be copies, or at least imitations, of those in the loggie of the Vatican. From hence you go through a long passage to the hall of ambassadors, which is magnificently decorated with innumerable varieties of mosaics, and the mottos of all the kings of Granada. This long narrow antichamber opens into the communa on the left hand, and on the right into the great audience-hall in the tower of Comares; a noble apartment, 36 feet square, 36 high up to the cornice, and 18 from thence to the centre of the cupola. The walls on three sides are 15 feet thick, on the other 9; the lower range of windows 13 feet high. The whole wall is inlaid with mosaic of many colours, disposed in intricate knots, stars, and other figures. In every part various Arabic sentences are repeated.

Having thus completed the tour of the upper apartments, which are upon a level with the offices of the new palace, you descend to the lower floor, which consisted of bedchambers and summer-rooms; the back stairs and passages, that facilitated the intercourse between them, are without number. The most remarkable room below is the king's bedchamber, which communicated by means of a gallery with the upper story. The beds were placed in two alcoves, upon a raised pavement of blue and white tiles; but as it was repaired by Philip V. who passed some time here, it cannot be said how it may have been in former times. A fountain played in the middle, to refresh the apartment in hot weather. Behind the alcoves are small doors, that conduct you to the royal baths. These consist of one small closet with marble cisterns for washing children, two rooms for grown-up persons, and vaults for boilers and furnaces that supplied the baths with water and the stoves with vapours. The troughs are formed of large slabs of white marble; the walls are beautified with party-coloured earthen ware; light is admitted by holes in the coved ceiling.

Hard by is a whispering gallery, and a kind of labyrinth, said to have been made for the diversion of the women and children. One of the passages of communication is fenced off with a strong iron grate, and called *the prison of the Sultana*; but it seems more probable that it was put up to prevent any body from climbing up into the women's quarter.

Under the council-room is a long slip, called *the king's study*; and adjoining to it are several vaults, said to be the place of burial of the royal family. In the year 1574, four sepulchres were opened; but as they contained nothing but bones and ashes, were immediately closed again.

This description of the Alhambra may be finished by observing how admirably every thing was planned and calculated for rendering this palace the most voluptuous of all retirements; what plentiful supplies of water were brought to refresh it in the hot months of summer; what a free circulation of air was contrived, by the judicious disposition of doors and windows; what shady gardens of aromatic trees; what noble views over the beautiful hills and fertile plains! No wonder

Ali. wonder the Moors regretted Granada! no wonder that they ſtill offer up prayers to God every Friday for the recovery of this city, which they regard as a terreſtrial paradiſe!

ALI, the ſon of Abu Taleb, is one of the moſt celebrated characters in Mahometan hiſtory. He was couſin to Mahomet; and at the age of fourteen engaged with youthful ardour in his cauſe. When Mahophet firſt revealed his prophetic character to his friends, and inquired who among them would undertake to be his companion, Ali exclaimed, "O Prophet, I will be thy attendant; the man who dares to riſe againſt thee I will break his legs, pluck out his eyes, daſh out his teeth, and even rip up his belly." Mahomet accepted his ſervices, and honoured him with the titles of brother, vicegerent, and Aaron to a new Moſes. He was remarkable both for eloquence and valour; and the latter obtained him the ſurname of "*the Lion of God, always victorious.*" He ſucceeded to the chief dignity of the renowned houſe of Haſhem, and was alſo hereditary guardian of the temple and city of Mecca. Mahomet gave him his daughter Fatimah in marriage, and the grandfather lived to embrace the children of his daughter. Theſe advantages induced Ali to caſt a wiſhful eye towards the regal ſucceſſion; however, Abubeker, Omar, and Othman reigned before him. But after the death of the latter he was ſaluted caliph by the chiefs of the tribes, and the companions of the Prophet, when he was repairing to the moſque of Medina at the hour of prayer, A. D. 655. Hegir. 35.

Ayeſha, the widow of the Prophet, ſtrenuouſly oppoſed his ſucceſſion; and under her influence two powerful chiefs ſoon raiſed the ſtandard of rebellion. Ali greatly increaſed his difficulties by the imprudent removal of all the governors of provinces from their ſtation. Telha and Zobeir, two chiefs of great influence, collected a numerous army, and induced Ayeſha to attend them to the field of battle; but Ali gained a complete victory and took Ayeſha priſoner. Telha fell in the field, and Zobeir was aſſaſſinated after ſurrendering upon promiſe of quarter. This daſtardly action was ſeverely reprehended by Ali. He likewiſe kindly treated the captive widow, and ſent her back to the tomb of the Prophet.

Ali next attacked Moawiyah, who had been proclaimed caliph, and ſtrongly ſupported by a powerful and numerous party. When the two armies approached each other, Ali propoſed to decide the matter by ſingle combat, but to this his opponent would not agree. Several ſkirmiſhes were fought with conſiderable loſs on both ſides; but at length a pious fraud produced a diviſion of ſentiment in the army of Ali. They fixed to the points of lances a number of copies of the Koran, carried them before the troops, and exclaimed, ſaying, "This is the book which forbids Muſſulmans to ſhed each others blood, and ought therefore to decide our diſputes." Ali was conſtrained to yield, and umpires were mutually choſen; on the ſide of Ali, Abu Mouſſa; Amru, the conqueror of Egypt, on the part of Moawiyah. The day of final deciſion arrived. Abu Mouſſa aſcended the pulpit, and cried, "As I draw this ring from my finger, ſo I depoſe both Ali and Moawiyah from the caliphate." When Amru aſcended, he cried, "As I put on this ring, ſo I inveſt Moawiyah with the caliphate, and alſo depoſe Ali." He alſo added, that Othman the former caliph had declared Moawiyah both his ſucceſſor and avenger. Thus began that memorable conteſt among the Mahometans which was long agitated with conſiderable violence by both parties. Ali.

Ali was highly enraged at this injuſtice; but, conſtrained for the preſent to yield, he retired to Kufa. A ſect of enthuſiaſts called the *Kharejites* revolted againſt Ali; but he quickly reduced them to ſubjection, and again obtained poſſeſſion of Arabia. But Syria, Perſia, and Egypt fell to the ſhare of his rival.

An unexpected event terminated the exiſting diſputes. Three Kharejites one day converſing together concerning the blood which had been ſhed, and the impending calamities, reſolved to aſſaſſinate Ali, Moawiyah, and Amru, the three authors of the preſent diſaſters. They provided themſelves with poiſoned ſwords, and haſtened to accompliſh their purpoſe. Moawiyah was wounded, but the wound did not prove fatal. A friend of Amru fell in his ſtead. Ali was fatally wounded at the door of the moſque, and in the ſixty-third year of his age, he expired on the fifth day after his wound, A. D. 660. A. Hegir. 40.

Ali had eight wives beſides Fatimah, and left a numerous family who were very remarkable for their valour. He alſo roſe to high eminence for learning and wiſdom; and of his works there are ſtill extant a hundred maxims, a collection of verſes, and a prophecy of all the great events which are to happen to the end of time. One of his ſayings may be quoted as an example. "He who would be rich without wealth, powerful without ſubjects, and a ſubject without a maſter, has only to forſake ſin, and ſerve God."

The Muſſulmans term Ali *the heir of Mahomet, and the accepted of God*, and his particular followers have poſſeſſed various ſtates in Africa and Aſia, and the Perſian part of the Uſbec Tartars; and ſome ſovereigns of India are at preſent of the ſect of Ali. A monument is raiſed upon his tomb near Kufa, which the kings of Perſia have ſucceſſively decorated and religiouſly revered. Near the ruins of Kufa a city named *Meſhed Ali* has been built to his memory. Some of his deluded followers imagine that he is ſtill alive, and that he will reviſit the earth and fill the ſame with juſtice. A green turban ſtill continues to diſtinguiſh the deſcendants of Ali. (*Gen. Biog.*)

ALI *Bey*, an eaſtern adventurer, is ſaid to have been a native of Mount Caucaſus, and about the age of twelve or fourteen he was ſold for a ſlave in Cairo. The two Jews who became his maſters preſented him to Ibrahim, then one of the moſt reſpectable men in the kingdom. In the family of this powerful man he received the rudiments of literature, and was alſo inſtructed in the military art. Both in letters and military ſkill he made a rapid improvement. He gradually gained the affection of his patron to ſuch a degree, that he gave him his freedom, permitted him to marry, promoted him to the rank of governor of a diſtrict, and afterwards by election he was raiſed to the elevated ſtation of one of the governors of provinces. Deprived of his protector by death, and engaging in the dangerous intrigues that pave the way to power in that unſtable government, he procured his own baniſhment to Upper-Egypt. Here he ſpent two years in maturing his schemes for future greatness, and in 1766, returning to Cairo, he either slew or expelled the beys, and seized the reins of government.

Emboldened by success, he rescued himself from the power of the Porte, coined money in his own name, and boldly assumed the rank of sultan of Egypt. Occupied in more important concerns, the Porte made no vigorous opposition to his measures, and Ali Bey seized this favourable opportunity to recover a part of the Said or Upper Egypt, which had been taken by an Arab shaik. Next he sent out a fleet from Suez, which seized upon Djedda, entered the port of Mecca; while a body of cavalry, commanded by Mohammed Bey his favourite, took and plundered Mecca itself. A young Venetian merchant laid before him a plan of reviving the ancient trade to the East Indies through the Mediterranean and Red seas. Having formed an alliance, in 1770, with one Shaik Daher, a rebel against the Porte in Syria, he aimed at the conquest of all Syria and Palestine. He first endeavoured to secure Gaza; then his army forming a junction with that of Daher at a place called Acre, advanced to Damascus. On the 6th of June 1771, a battle was fought at this place with the Turkish pachas, and Mohammed and Daher the commanders of Ali Bey routed them with great slaughter. They instantly took possession of Damascus, and the castle itself had also capitulated, when all on a sudden Mohammed hastened back to Egypt with all his Mamelukes. Some ascribe this strange conduct to an impression made upon Mohammed by the Turkish agents, and others to a report of the death of Ali Bey.

Although unsuccessful, Ali Bey never lost sight of his favourite object, and Mohammed losing his confidence was forced to save his life by exile. Mohammed, however, quickly returned with an army and drove Ali Bey from Cairo. In this unfortunate state of affairs Ali Bey fled to Daher, and combining their forces, they attacked the Turkish commander at Sidon, and came off victorious, although the Turkish army was three times their number. After a siege of eight months they next took the town of Jaffa. Deceived by letters from Cairo which were only intended to ensnare him, and stimulated with recent victories, he returned to Cairo. Entering the deserts which divide Gaza from Egypt, he was furiously attacked by a thousand chosen Mamelukes led on by Murad Bey, who was enamoured with the beauty of Ali Bey's wife, and had obtained the promise of her, provided that he could take Ali Bey captive. Murad wounded and made Ali Bey prisoner, and carried him to Mohammed, who received him with affected respect: but in three days, either in consequence of poison or the effects of his wounds, Ali breathed his last.

Ali Bey was certainly a singular production in the school of ignorance and barbarity, and displayed a very great degree of original vigour of character and active penetration of mind. He is blamed for engaging in enterprises beyond his power to accomplish; but he is acknowledged to have been very favourable to the Franks, and to have governed Egypt with no small degree of steady moderation. He is also charged with devolving too much upon his lieutenants, and not being sufficiently attentive to the exactions made by his officers. Among his failings may also be ranked that of an unbounded confidence in his favourite. Generosity and a sense of justice were not wanting in his character, although his morals, under the sanction of his class and country, were strongly tainted with perfidy and murder in the pursuit of his ambitious plans. (*Gen. Biog.*)

ALJAMEIA is a name which the Moriscoes in Spain give to the language of the Spaniards. Among other articles agreed on by the junto, which was appointed by the emperor Charles V. in 1526, in favour of the Moriscoes, this was one, That the Moriscoes should no longer speak Algavareia, i. e. Moorish, or Arabic; but should all speak *Aljameia*, i. e. Spanish, as it was called by the Moors, and all their writings and contracts should be in that language.

ALIAS, in *Law*, a second or farther writ issued from the courts of Westminster, after a *capias*, &c. sued out without effect.

ALIBI, in *Law*, denotes the absence of the accused from the place where he is charged with having committed a crime; or his being *elsewhere*, as the word imports, at the time specified.

ALICANT, a large sea-port town in the province of Valencia, and territory of Segura. It is seated between the mountains and the sea, and has a castle deemed impregnable. The port is defended by three bastions furnished with artillery. To prevent the visits of the Algerine pirates, watch-towers were built to give notice of the approach of an enemy's ship. It was taken from the Moors in 1264. The castle was taken by the English in 1706, and held out a siege of two years before it was retaken by the French and Spaniards, and at last surrendered upon honourable terms, after part of the rock was blown up on which the castle stood, and the governor killed. The houses are high, and well built; and a very great trade is carried on here, particularly in wine and fruit. It is seated on the Mediterranean, on a bay of the same name, 37 miles north-east of Murcia, and 75 south of Valencia. W. Long. 0. 36. N. Lat. 38. 24.

ALICATA, a mountain of Sicily, near the valleys Mazara and Noto, upon which was situated (as is generally thought) the famous Dædalion, where the tyrant Phalaris kept his brazen bull.

ALICATA, a town of Sicily, remarkable for corn and good wine. It was plundered by the Turks in 1543; and is seated on a sort of peninsula near the sea, 22 miles south-east of Girgenti. E. Long. 15. 20. N. Lat. 37. 11.

ALICATA Chlamys, was a sort of vest with sleeves worn by the Roman boys till the age of thirteen, at which time they put on the *pretexta*.

ALIEN, in *Law*, implies a person born in a strange country, not within the king's allegiance; in contradistinction to a denizen or natural subject. The word is formed from the Latin *alius*, "another;" q. d. one born in another country. An alien is incapable of inheriting lands in Britain till naturalized by an act of parliament. No alien is entitled to vote at the election of members of parliament; nor can he enjoy any office, or be returned on any jury, unless where an alien is party in a cause, when the inquest is composed of an equal number of denizens and aliens. The reasons for establishing these laws were, that every man is presumed to bear faith and love to that prince and country where he received protection during his infancy;

Alien, Alienation.

cy; and that one prince might not ſettle ſpies in another's country; but chiefly that the rents and revenues of the country might not be drawn to the ſubjects of another. Some have thought that the laws againſt aliens were introduced in the time of Henry II. when a law was made at the parliament of Wallingford, for the expulſion of ſtrangers, in order to drive away the Flemings and Picards introduced into the kingdom by the wars of King Stephen. Others have thought that the origin of this law was more ancient; and that it is an original branch of the feudal law: for by that law no man can purchaſe any lands but he muſt be obliged to do fealty to the lords of whom the lands are holden; ſo that an alien who owed a previous faith to another prince, could not take an oath of fidelity in another ſovereign's dominions. Among the Romans only the *Cives Romani* were eſteemed freemen; but when their territories increaſed, all the Italians were made free under the name of *Latins*, though they had not the privilege of wearing gold rings till the time of Juſtinian. Afterwards all born within the pale of the empire were conſidered as citizens.

Alien-Duty, an impoſt laid on all goods imported by aliens, over and above the cuſtoms paid for ſuch goods imported by Britiſh, and on Britiſh bottoms.

Aliens-Duty is otherwiſe called *petty cuſtoms*, and *navigation duty*.---Fiſh dried or ſalted, and cod-fiſh or herring not caught in Britiſh veſſels and cured by Britiſh ſubjects, pay a double *aliens-duty*.---On what footing aliens are permitted to import foreign commodities into Great Britain, ſee Duty.

Alien-Priories, a kind of inferior monaſteries, formerly very numerous in England, and ſo called from their belonging to foreign abbeys.

ALIENATION, in *Law*, denotes the act of making over a man's property in lands, tenements, &c. to another perſon.

Alienation *in mortmain*, is making over lands, tenements, &c. to a body politic, or to a religious houſe, for which the king's licenſe muſt firſt be obtained, otherwiſe the lands, &c. alienated will be forfeited.

Alienation in fee is the ſelling the fee-ſimple of any land or other incorporeal right. All perſons who have a right to lands may generally alien them to others: but ſome alienations are prohibited; ſuch as alienations by tenants for life, &c. whereby they incur a forfeiture of their eſtate. By the ſtatute of Edward I. a bar was put to alienations by what we call *entails*, which is an expedient for procuring perpetuities in families; but counter-expedients were deviſed to defeat this intent, and a practice was introduced of cutting off entails by fines, and of barring remainders and reverſions by recoveries. The ſtatute for alienations in Henry VII.'s time had a great effect on the conſtitution of this kingdom; as, among other regulations of that reign, it tended to throw the balance of power more into the hands of the people. By the ſtat. 12 Car. II. cap. 24. fines for alienations are taken away. Crown lands are only alienable under a faculty of perpetual redemption. The council of Lateran, held in 1123, forbids any clerk to alienate his benefice, prebend, or the like. By the laws of the ancient Jews, lands could only be alienated for the ſpace of 50 years. At each return of the jubilee all returned again to the primitive owners, or their deſcendants, to whom the lands were originally allotted at the firſt diſtribution of Canaan.

Alienation, Aliment.

Alienation-Office, is an office to which all writs of covenants and entry, upon which fines are levied, and recoveries ſuffered, are carried, to have fines for alienation ſet and paid thereon.

ALIMENT (from *alo* to nouriſh), implies food both ſolid and liquid: from which, by the proceſs of digeſtion, is prepared a very mild, ſweet, and whitiſh liquor, reſembling milk, and diſtinguiſhed by the name of *chyle*; which being abſorbed by the lacteal veins, by them conveyed into the circulation, and there aſſimilated into the nature of blood, affords that ſupply of nutrition which the continual waſte of the body is found to require.—Next to air, food is the moſt neceſſary thing for the preſervation of our bodies: and as on the choice thereof our health greatly depends, it is of great importance to underſtand, in general, what is the propereſt for our nouriſhment; and, in particular deviations from health, what is the beſt adapted to reſtore us. The blood and fluids naturally incline to waſte and diminiſh: freſh chyle, duly received, prevents this waſte and diminution, and preſerves in them that mild ſtate which alone conſiſts with health. An animal diet affords the moſt of this bland nutritious mucilage; watery fluids dilute the too groſs parts, and carry off what is become unfit for uſe. It is only the ſmall portion of jelly which is ſeparated from the farinaceous parts of vegetables, that, after being much elaborated, is converted into the animal nature; yet the uſe of vegetables prevents both repletion and a too great tendency to a putreſcent acrimony of the blood. In hot climates, as well as againſt the conſtitutional heat of particular perſons, vegetables are demanded in the largeſt proportion. Animal ſubſtances afford the higheſt reliſh while our appetite continues; but will ſate the appetite before the ſtomach is duly filled. Vegetables may be eaten after either fleſh or fiſh: few herbs or fruits ſatiate ſo much as that the ſtomach may not be filled with them, when it is already ſatisfied with fleſh or fiſh; whence it may be obſerved, that no diet which is very nouriſhing can be eaten to fulneſs, becauſe its nutritious parts are oily and ſatiating. Health depends almoſt wholly on a proper craſis of the blood; and to preſerve this a mixture of vegetables in ſome degree is always required, for a loathing is ſoon the conſequence of animal food alone: hot acrid habits, too, receive from milk and vegetables the needful for correcting their exceſſes; but in cold, pituitous, and nervous habits, who want moſt nouriſhment from leaſt digeſtion, and from the ſmalleſt quantity of food, animal diet is to be uſed more freely.

Thus much being offered as general principles with reſpect to the matter and quality of our aliment, the valetudinarian may eaſily regulate his diet with ſome advantage to himſelf by an attention to the few enſuing particulars. In winter, eat freely, but drink ſparingly: roaſt meat is to be preferred, and what is drunk ſhould be ſtronger than at other ſeaſons. In ſummer, let thirſt determine the quantity to be drunk; cold ſtomachs never require much: boiled meats and vegetables, if not otherwiſe contraindicated, may now be more freely uſed. Lax habits require the winter's diet to be continued all the year, and rigid ones ſhould be confined to that of ſummer. Fat people ſhould faſt at times, but the lean ſhould never do ſo. Thoſe who are troubled with eructations occaſioned by their food ſhould drink but little, and uſe ſome unaccuſtomed exerciſe. The thirſty ſhould drink freely, but eat ſparingly. In general, let moderation be obſerved; and though no dinner hath been had, a light ſupper is at all times to be preferred. After very high ſeaſoned meats, a glaſs of water acidulated with the acid elixir of vitriol, or in very weak ſtomachs the ſweet elixir of vitriol, is far more aſſiſtant to the work of digeſtion than the common method of taking brandy. See further FOOD and DRINK.

Obligation of ALIMENT, in *Scots Law*, the natural obligation on parents to provide their children with the neceſſaries of life, &c. See LAW *Index*.

ALIMENTARII Pueri, &c. were certain children maintained and educated by the munificence of the emperors, in a ſort of public places, not unlike our hoſpitals.—Trajan was the firſt who brought up any of theſe alimentary boys. He was imitated by Adrian. Antoninus Pius did the ſame for a number of maids, at the ſolicitation of Fauſtina; and hence, in ſome medals of that empreſs, we read PVELLAE FAVSTINIANAE.—Alexander Severus did the like at the requeſt of Mammæa; and the maids thus educated were called *Mammæanæ*.

ALIMENTARY Duct or *Canal*, is a name given by Dr Tyſon and ſome others to that part of the body through which the food paſſes from its reception into the mouth to its exit at the *anus*; including the *gula*, ſtomach, and inteſtines. See ANATOMY.

This duct has been ſaid to be the true characteriſtic of an animal, or (in the jargon of the ſchools) *in proprium quarto modo*; no animal being without it. Plants receive their nouriſhment by the numerous fibres of their roots; but have no common receptacle for digeſting the food received, or for carrying off the recrements. But in all, even the loweſt degree of animal life, we may obſerve a ſtomach and inteſtines, even where we cannot perceive the leaſt formation of any organ of the ſenſes, unleſs that common one of feeling, as in oyſters. *Phil. Tranſ.* N° 269, p. 776, *et ſeq.*

Dr Wallis brings an argument from the ſtructure of the alimentary tube in man, to prove that he is not naturally carnivorous; to which Dr Tyſon makes ſome objections. *Vid. Phil. Tranſ.* N° 269. p. 777.

ALIMENTARY Law, *lex alimentaria*, was an old law among the Romans, whereby children were obliged to find ſuſtenance for their parents.

ALIMONY, in *Law*, implies that allowance which a married woman ſues for, and is entitled to, upon any occaſional ſeparation from her huſband. See LAW *Index*.

ALIPILARIUS, or ALIPILUS, in *Roman Antiquity*, a ſervant belonging to the baths, whoſe buſineſs it was, by means of waxen plaſters, and an inſtrument called *volſella*, to take off the hairs from the arm pits, and even arms, legs, &c. this being deemed a point of cleanlineſs.

ALIPTERIUM, ἀλειπτήριον, in *Antiquity*, a place in the ancient *paleſtræ*, where the *athletæ* were anointed before their exerciſes.

ALIQUANT PART, in *Arithmetic*, is that number which cannot meaſure any other exactly without ſome remainder. Thus 7 is an aliquant part of 16; for twice 7 wants two of 16, and three times 7 exceeds 16 by 5.

ALIQUOT PART, is that part of a number or quantity which will exactly meaſure it without any remainder. Thus 2 is an aliquot part of 4, 3 of 9, 4 of 16, &c.

ALISANDERS, or ALEXANDERS, in *Botany*. See SMYRNIUM, BOTANY *Index*.

ALISONTIA, or ALISUNTIA, in *Ancient Geography*, a river of Belgic Gaul, now *Alſitz*; which, riſing on the borders of Lorrain, and running through that duchy, waters the city of Luxemburgh, and, ſwelled by other rivulets, falls into the Sur.

ALITES, in *Roman Antiquity*, a deſignation given to ſuch birds as afforded matter of auguries by their flight.

ALKADARII, a ſect among the Mahometans who deny any eternal, fixed, divine decrees, and are aſſertors of free-will. The word is formed from the Arabic *alkadar*, which ſignifies "decree." The Alkadarii are a branch of Motazalites, and ſtand oppoſed to the Algiabarii. See ALGIABARII.

ALKAHEST, or ALCAHEST, among *Alchemiſts*, derived from a word which ſignifies *ſpirit of ſalt*, or *all-ſpirit*, was ſuppoſed to be an univerſal menſtruum capable of reſolving all bodies into their firſt principles. Van Helmont pretended he was poſſeſſed of ſuch a menſtruum.—It is likewiſe uſed by ſome authors for all fixed ſalts volatilized.

ALKALI, in *Chemiſtry*, denotes a particular claſs of ſalts. The word *alkali* is of Arabian origin, and was introduced into chemiſtry after it had been applied to a plant which ſtill retains the name of *kali*. When this plant is burnt, the aſhes waſhed in water, and the water evaporated to dryneſs, a white ſubſtance remains, which was called *alkali*. According to Albertus Magnus, who uſes the word, it ſignifies *fæx amaritudinis*, "the dregs of bitterneſs." Alkali may be obtained from other ſubſtances beſides kali. Chemiſts gradually diſcovered that bodies, differing from one another in ſeveral of their properties, had been confounded together under the ſame name. The word, in conſequence, became general, and is now applied to all bodies which poſſeſs the following properties: 1. Incombuſtible. 2. A hot cauſtic taſte. 3. Volatilized by heat. 4. Soluble in water even when combined with carbonic acid. 5. Capable of converting vegetable blues to green.

The alkalies at preſent known are three in number: 1. Potaſs; 2. Soda; 3. Ammonia. The two firſt are called *fixed alkalies*, becauſe they require a red heat to volatilize them; the laſt is called *volatile alkali*, becauſe it readily aſſumes a gaſeous form, and conſequently is diſſipated by a very moderate degree of heat. See CHEMISTRY *Index*.

ALKALI, or *Sal Kali*. See SALICORNIA, BOTANY *Index*.

ALKANET. See ANCHUSA, BOTANY *Index*.

ALKEKENGI, the trivial name of a ſpecies of phyſalis. See PHYSALIS, BOTANY *Index*.

ALKENNA. See LAWSONIA, BOTANY *Index*.

ALKERMES, in *Pharmacy*, a compound cordial medicine made in the form of a confection, deriving its name from the kermes berries uſed in its compoſition.

ALKORAN. See ALCORAN.

ALL-HALLOWS. See *All-Saints*.

All-Good. See CHENOPODIUM, BOTANY *Index*.

All-Heal. See HERACLEUM and STACHYS, BOTANY *Index*.

All-Saints, in the *Kalendar*, denotes a festival celebrated on the first of November, in commemoration of all the saints in general; which is otherwise called *All-Hallows*. The number of saints being so excessively multiplied, it was found too burdensome to dedicate a feast day to each. In reality, there are not days enough, scarce hours enough, in the year, for this purpose. Hence an expedient was had recourse to, by commemorating such in the lump as had not their own days. Boniface IV. in the ninth century, introduced the feast of *All-Saints* in Italy, which was soon after adopted into the other churches.

All-Saints, islands near Guadaloupe, in the West Indies.

All-Saints, a parish in Georgetown district, South Carolina, containing 2225 inhabitants, of whom 429 are whites, and 1795 slaves. It sends a member to each house of the state legislature.

All-Saints Bay, a spacious harbour near St Salvador in Brazil, in S. America, on the Atlantic ocean, W. Long. 40°, S. Lat. 12°.

All-Saints Bay, a captainship in the middle division of Brasil, so called from the harbour of that name, bounded on the north by the Rio Real; on the south by that of Las Ilheos; on the east by the ocean; and on the west by three unconquered nations of Indians. It is reckoned one of the richest and most fertile captainships in all Brazil, producing great quantities of cotton and sugar. The bay itself is about two and a half leagues over, interspersed with a number of small but pleasant islands, and is of prodigious advantage to the whole country. It has several cities and towns, particularly St Salvador, which is its capital. All-Saints Bay lies in S. Lat. 12. 3. W. Long. 40. 10. See SALVADOR.

All-Souls, in the *Kalendar*, denotes a feast-day, held on the second of November, in commemoration of all the faithful deceased.—The feast of All-Souls was first introduced in the eleventh century, by Odilon abbot of Cluny, who enjoined it on his own order; but it was not long before it became adopted by the neighbouring churches.

All-Spice. See MYRTUS and CALYCANTHUS, BOTANY *Index*.

ALLA, or ALLAH, the name by which the professors of Mahometanism call the Supreme Being.

The term *alla* is Arabic, derived from the verb *alah*, to adore. It is the same with the Hebrew *Eloah*, which signifies the *Adorable Being*.

ALLAHABAD, in *Geography*, a province of Hindostan, about 160 miles in length, and 120 in breadth. Its eastern boundaries meet the province of Bahar, the southern Berar, the western Malwa and Agra, and the northern Oude. According to the distribution of the emperor Akbar, recorded in the Ayeen Akberry; it contains 10 circars or counties, which are divided into 177 pergunnahs or hundreds. According to the statement of Maurice, in his Indian antiquities, it affords a revenue of 3,310,695 sicca rupees. It contributes to the public service 323 elephants, 237,870 infantry, and 11,375 cavalry. Azuph Dowla, a tributary ally of the British power, possesses the greater part of this province. Allahabad, Benares, and Iconpour, are the principal cities.

ALLAHABAD, the capital of the above province, is situated at the confluence of the great rivers Jumna and Ganges. This city is divided into two parts, called *the Old* and *the New Town*: The old is situated upon the Ganges, and the new upon the Jumna. The emperor Akbar erected a strong fortress of stone, which occupies a large space in this city, and from him it received its present name. Of this fortress, Mr Hodges, in N° IV. of his select views in India, gives an accurate and elegant delineation. A pillar consisting of one stone 40 feet high, ascribed by tradition to Bima, one of the heroes of Mahabarat, wholly covered with illegible inscriptions, and the elegant tomb of Sultan Khusru, are excellent specimens of Mahometan architecture. Devotion has fixed her residence, and flourishes to such a degree in this city, that it hath obtained the appellation of "the king of worshipped places." According to the evidence of the Ayeen-Akberry, the adjacent territory, to the extent of 40 miles, is deemed holy ground. In such veneration is this place held by the Hindoos, that when a man dies here, they believe he will obtain the utmost of his wishes in his next regeneration. They deem it a meritorious action for a man to slay himself, although they teach that suicide will be punished with torments in a future state. In and about this city there are various objects of veneration, which immense numbers of pilgrims continue to visit with great devotion. Major Rennel has placed Palibothra on the same site with Patna; but Dr Robertson is of opinion that the ancient Palibothra is the modern city of Allahabad. N. Lat. 25. 27. E. Long. 82. 5.

ALLAMANDA, in *Botany*. See BOTANY *Index*.

ALLAN, a river of Perthshire, in Scotland, which passes by Dunblane, and falls into the Forth near Stirling.

ALLANTOIS, or ALLANTOIDES, a thin transparent bag investing the fœtus of quadrupeds, as cows, goats, sheep, &c. filled with an urinous liquor conveyed to it from the bladder of the young animals by means of the urachus. See ANATOMY *Index*.

ALLATIUS, LEO, keeper of the Vatican library, a native of Scio, and a celebrated writer of the 17th century. He was of great service to the gentlemen of Port Royal in the controversy they had with M. Claude touching the belief of the Greeks with regard to the eucharist. No Latin was ever more devoted to the see of Rome, or more inveterate against the Greek schismatics, than Allatius. He never was married; nor did he take orders; and Pope Alexander VII. having asked him one day, why he did not enter into orders? he answered, Because I would be free to marry." The pope rejoined, "If so, why do you not marry? "Because," replied Allatius, "I would not be at liberty to take orders." Thus, as Mr Bayle observes, he passed his whole life, wavering betwixt a parish and a wife; sorry, perhaps, at his death, for having chosen neither of them; when, if he had fixed upon one, he might have repented his choice for 30 or 40 years.—If we believe John Patricius, Allatius had a very extraordinary pen, with which, and no other, he wrote Greek for 40 years; at the loss of which, he was so grieved

grieved as to lament it with tears. He publiſhed ſeveral manuſcripts, ſeveral tranſlations of Greek authors, and ſeveral pieces of his own compoſing. In his works he diſcovers more erudition and induſtry than ſound judgment. His manner of writing is diffuſe and perplexed, making frequent digreſſions from one ſubject to another. He died at Rome in 1669, aged 83.

ALLAY. See Alloy.

ALLECTUS, the prime miniſter and confidential friend of Carauſius, emperor of Britain. In order to avoid the puniſhment due to the ſeveral enormous crimes with which he was chargeable, he fell upon the deſperate expedient of murdering his maſter, and uſurping the imperial dignity, which he maintained for three years. With a deſign of recovering Britain, Conſtantius about this period fitted out a large ſquadron, which being aſſembled in the mouth of the Seine, the command was devolved upon the prefect Aſclepiodotus. The fleet of Allectus was ſtationed off the Iſle of Wight to receive them; but under the cover of a thick fog, the invaders eſcaped their notice, and landed in ſafety on the weſtern coaſt, and, according to Gibbon, convinced the Britons "that a ſuperiority of naval ſtrength will not always protect their country from a foreign invaſion." No ſooner had the intrepid commander diſembarked his forces, than he ſet fire to his ſhips, and marched forward to meet the enemy. In expectation of an attack from Conſtantius, who commanded the fleet off Boulogne, the uſurper had taken his ſtation in the vicinity of London; but informed of the deſcent of Aſclepiodotus, he made forced marches to oppoſe his progreſs. Allectus attacked the imperial troops, and his army being reduced to a ſmall number of fatigued and diſpirited men, he fell in the field, and his forces received a total defeat. Thus, in one day, and by a ſingle battle, the fate of this great iſland was decided; and Britain, after a ſeparation of 10 years, was reſtored to the Roman empire, A. D. 297. Conſtantius landing on the ſhores of Kent, was ſaluted with the loud applauſes and unanimous acclamations of obedient ſubjects, and welcomed to the Britiſh ſoil.

ALLEGATA, a word anciently ſubſcribed at the bottom of reſcripts and conſtitutions of the emperors; as *ſignata*, or *teſtata*, was under other inſtruments.

ALLEGEAS, or Allegias, a ſtuff manufactured in the Eaſt Indies. There are two ſorts of them; ſome are of cotton, and others of ſeveral kinds of herbs, which are ſpun like flax and hemp. Their length and breadth are of eight ells, by five, ſix, or ſeven eighths; and of twelve ells, by three-fourths or five-eighths.

ALLEGHANY, is the moſt weſtern county in Maryland, and has Pennſylvania on the north. The windings of the Patowmac river ſeparate it from Virginia on the ſouth, and Sideling-hill Creek divides it from Waſhington county on the eaſt. It contains 4809 inhabitants, including 258 ſlaves. Cumberland is its chief town.

Alleghany *County*, in Pennſylvania, extends from the junction of the river of that name with the Ohio, where its chief town, Pittſburg, is ſituated, to the New-York line. It contains 10,309 inhabitants, including 159 ſlaves.

Alleghany *Mountains*, between the Atlantic ocean, the Miſſiſſippi river, and the lakes, are a long and broad range of mountains, made up of a great number of ridges, extending north-eaſterly and ſouth-weſterly, nearly parallel to the ſea coaſt, about 900 miles in length, and from 60 to 150 and 200 miles in breadth. Mr. Evans obſerves, with reſpect to that part of theſe mountains which he travelled over, viz. in the back parts of Pennſylvania, that ſcarcely one acre in ten is capable of culture. This, however, is far from being the caſe in all parts of this range. Numerous tracts of fine arable and grazing land intervene between the ridges. The different ridges which compoſe this immenſe range of mountains, have different names in the different ſtates, viz. the *Blue Ridge*, the *North Mountain*, or *North Ridge*, or *Devil's Back-Bone*, *Laurel Ridge*, *Jackſon's Mountains*, and *Kittatinny Mountains*. All theſe different and immenſe ridges, except the *Alleghany*, are broken through by rivers, which appear to have forced their way through ſolid rocks. This principal ridge is more immediately called *Alleghany*, and is deſcriptively named the *Back-bone of the United States*. From theſe ſeveral ridges proceed innumerable branches, or ſpurs.

The general name of the whole range, taken collectively, ſeems not yet to have been determined. Mr Evans calls them the *Endleſs Mountains;* others have called them the *Appalachian Mountains*, from a tribe of Indians who live on a river which proceeds from this mountain, called the *Appalachicola;* but the moſt common name is the *Alleghany Mountains*, ſo called, probably, from the principal ridge of the range. Theſe mountains are not confuſedly ſcattered, riſing here and there into high peaks, overtopping each other; but run along in uniform ridges, ſcarcely half a mile high. They ſpread as you proceed ſouth, and ſome of them terminate in high perpendicular bluffs: others gradually ſubſide into a level country, giving riſe to the rivers which run ſoutherly into the gulf of Mexico.

Alleghany *River*, in Pennſylvania, riſes on the weſtern ſide of the Alleghany mountains, and after running about 200 miles in a ſouth-weſt direction, meets the Monongahela at Pittſburg, and both united form the Ohio. The lands on each ſide of this river, for 150 miles above Pittſburg, conſiſt of white oak and cheſnut ridges, and in many places of poor pitch pines, interſperſed with tracts of good land, and low meadows. This river, and the Ohio likewiſe, from its head waters until it enters the Miſſiſſippi, are known and called by the name of *Alleghany River*, by the Seneka, and other tribes of the Six Nations, who once inhabited it.

ALLEGIANCE, in *Law*, is the tie, or *ligamen*, which binds the ſubject to the king, in return for that protection which the king affords the ſubject. The thing itſelf, or ſubſtantial part of it, is founded in reaſon and the nature of government; the name and the form are derived to us from our Gothic anceſtors. Under the feodal ſyſtem, every owner of lands held them in ſubjection to ſome ſuperior or lord, from whom or from whoſe anceſtors the tenant or veſſel had received them; and there was a mutual truſt or confidence ſubſiſting between the lord and vaſſal, that the lord ſhould protect the vaſſal in the enjoyment of the territory he had granted him; and, on the other hand, that the vaſſal ſhould be faithful to the lord, and defend him againſt all his enemies. This obligation on the part of the vaſſal was called his

fidelitas

Allegiance. *fidelitas* or fealty: and an oath of fealty was required by the feodal law to be taken by all tenants to their landlord, which is couched in almoſt the ſame terms as our ancient oath of allegiance; except that, in the uſual oath of fealty, there was frequently a ſaving or exception of the faith due to a ſuperior lord by name, under whom the landlord himſelf was perhaps only a tenant or vaſſal. But when the acknowledgment was made to the abſolute ſuperior himſelf, who was vaſſal to no man, it was no longer called the oath of fealty, but the oath of allegiance; and therein the tenant ſwore to bear faith to his ſovereign lord, in oppoſition to all men, without any ſaving or exception. Land held by this exalted ſpecies of fealty, was called *feudum ligium*, a liege fee; the vaſſals *homines ligii*, or liege men; and the ſovereign, their *dominus ligius*, or liege lord. And when ſovereign princes did homage to each other for lands held under their reſpective ſovereignties, a diſtinction was always made between *ſimple* homage, which was only an acknowledgment of tenure; and *liege* homage, which included the fealty before mentioned, and the ſervices conſequent upon it. In Britain, it becoming a ſettled principle of tenure, that all lands in the kingdom are holden of the king as their ſovereign and lord paramount, no oath but that of fealty could ever be taken to inferior lords; and the oath of allegiance was neceſſarily confined to the perſon of the king alone. By an eaſy analogy, the term of *allegiance* was ſoon brought to ſignify all other engagements which are due from ſubjects to their prince, as well as thoſe duties which were ſimply and merely territorial. And the oath of allegiance, as adminiſtered in England for upwards of 600 years, contained a promiſe "to be true and faithful to the king and his heirs, and truth and faith to bear of life and limb and terrene honour, and not to know or hear of any ill or damage intended him, without defending him therefrom." But, at the Revolution, the terms of this oath being thought perhaps to favour too much the notion of non-reſiſtance, the preſent form was introduced by the convention parliament, which is more general and indeterminate than the former; the ſubject only promiſing "that he will be faithful and bear *true* allegiance to the king," without mentioning "his heirs," or ſpecifying in the leaſt wherein that allegiance conſiſts. The oath of ſupremacy is principally calculated as a renunciation of the pope's pretended authority: and the oath of abjuration, introduced in the reign of King William, very amply ſupplies the looſe and general texture of the oath of allegiance; it recognizing the right of his majeſty, derived under the act of ſettlement; engaging to ſupport him to the utmoſt of the juror's power; promiſing to diſcloſe all traiterous conſpiracies againſt him; and expreſsly renouncing any claim of the deſcendants of the late pretender, in as clear and explicit terms as the Engliſh language can furniſh. This oath muſt be taken by all perſons in any office, truſt, or employment; and may be tendered by two juſtices of the peace to any perſon whom they ſhall ſuſpect of diſaffection. And the oath of allegiance may be tendered to all perſons above the age of twelve years, whether natives, denizens, or aliens.

Blackſtone's Comment.

But, beſides theſe *expreſs* engagements, the law alſo holds that there is an *implied*, *original*, and *virtual* allegiance, owing from every ſubject to his ſovereign, antecedently to any expreſs promiſe, and although the ſubject never ſwore any faith or allegiance in form. Thus Sir Edward Coke very juſtly obſerves, that "all ſubjects are equally bounden to their allegiance as if they had taken the oath; becauſe it is written by the finger of the law in their hearts, and the taking of the corporal oath is but an outward declaration of the ſame."

Allegiance, both expreſs and implied, is however diſtinguiſhed by the law into two ſorts or ſpecies, the one *natural*, the other *local;* the former being alſo perpetual, the latter temporary.

Natural allegiance is ſuch as is due from all men born within the king's dominions immediately upon their birth. For, immediately upon their birth, they are under the king's protection; at a time too, when (during their infancy) they are incapable of protecting themſelves. Natural allegiance is, therefore, a debt of gratitude; which cannot be forfeited, cancelled, or altered, by any change of time, place, or circumſtance, nor by any thing but the united concurrence of the legiſlature. A Briton who removes to France, or to China, owes the ſame allegiance to the king of Britain there as at home, and 20 years hence as well as now. For it is a principle of univerſal law, That the natural born ſubject of one prince cannot by any act of his own, no, not by ſwearing allegiance to another, put off or diſcharge his natural allegiance to the former: for this natural allegiance was intrinſic and primitive, and antecedent to the other; and cannot be diveſted without the concurrent act of that prince to whom it was firſt due.

Local allegiance is ſuch as is due from an alien, or ſtranger born, for ſo long time as he continues within the king's dominion and protection; and it ceaſes the inſtant ſuch ſtranger transfers himſelf from this kingdom to another. Natural allegiance is therefore *perpetual*, and local *temporary* only; and that for this reaſon, evidently founded upon the nature of government. That allegiance is a debt due from the ſubject, upon an implied contract with the prince; that ſo long as the one affords protection, ſo long the other will demean himſelf faithfully.

The *oath* of allegiance, or rather the *allegiance* itſelf, is held to be applicable, not only to the political capacity of the king, or regal office, but to his natural perſon and blood royal: and for the miſapplication of their allegiance, viz. to the regal capacity or crown, excluſive of the perſon of the king, were the Spencers baniſhed in the reign of Edward II. And from hence aroſe that principle of perſonal attachment and affectionate loyalty, which induced our forefathers (and, if occaſion required, would doubtleſs induce their ſons) to hazard all that was dear to them, life, fortune, and family, in defence and ſupport of their liege lord and ſovereign.

Paley's Moral and Political Philoſophy.

It is to be obſerved, however, in explanation of this allegiance, That it does not preclude reſiſtance to the king, when his miſconduct or weakneſs is ſuch as to make reſiſtance beneficial to the community. It ſeems fairly preſumable, that the convention parliament, which introduced the oath of allegiance in its preſent form, did not intend to exclude all reſiſtance: ſince the very

Allegory. very authority by which the members sat together, was itself the effect of a successful opposition to an acknowledged sovereign.

Again: The allegiance above described can only be understood to signify obedience to lawful commands. If, therefore, the king should issue a proclamation, levying money or imposing any service or restraint upon the subject, beyond what the law authorized, there would exist no sort of obligation to obey such a proclamation, in consequence of having taken the oath of allegiance.

Neither can allegiance be supposed to extend to the king after he is actually and absolutely deposed, driven into exile, or otherwise rendered incapable of exercising the regal office. The promise of allegiance implies, that the person to whom the promise is made continues king; that is, continues to exercise the power, and afford the protection, which belong to the office of king; for it is the possession of these which makes such a particular person the object of the oath.

ALLEGORY, in *Composition*, consists in choosing a secondary subject, having all its properties and circumstances resembling those of the principal subject, and describing the former in such a manner as to represent the latter. The principal subject is thus kept out of view, and we are left to discover it by reflection. In other words, an allegory is, in every respect, similar to a hieroglyphical painting, excepting only that words are used instead of colours. Their effects are precisely the same: A hieroglyphic raises two images in the mind; one seen, that represents one that is not seen: An allegory does the same; the representative subject is described, and the resemblance leads us to apply the description to the subject represented.

There cannot be a finer or more correct allegory than the following, in which a vineyard is made to represent God's own people the Jews:

"Thou hast brought a vine out of Egypt; thou hast cast out the heathen, and planted it. Thou didst cause it to take deep root, and it filled the land. The hills were covered with its shadow, and the boughs thereof were like the goodly cedars. Why hast thou then broken down her hedges, so that all that pass do pluck her? The boar out of the wood doth waste it, and the wild beast doth devour it. Return, we beseech thee, O God of hosts: look down from heaven, and behold, and visit this vine and the vineyard thy right hand hath planted, and the branch thou madest strong for thyself," Psal. lxxx.

Nothing gives greater pleasure than an allegory, when the representative subject bears a strong analogy, in all its circumstances, to that which is represented. But most writers are unlucky in their choice, the analogy being generally so faint and obscure, as rather to puzzle than to please. Allegories, as well as metaphors and similies, are unnatural in expressing any severe passion which totally occupies the mind. For this reason, the following speech of Macbeth is justly condemned by the learned author of the Elements of Criticism:

Methought I heard a voice cry, Sleep no more!
Macbeth doth murder Sleep; the innocent sleep;
Sleep that knits up the ravell'd sleeve of Care,
The birth of each day's life, sore Labour's bath,
Balm of hurt minds, great Nature's second course,
Chief nourisher in life's feast. *Act.* ii. *Sc.* 3.

But see this subject more fully treated under the article *Metaphor and Allegory*.

Allegri. ALLEGRI, Antonio, called *Corregio* from the place of his birth, an eminent historical painter, was born in the year 1494. Being descended of poor parents, and educated in an obscure village, he enjoyed none of those advantages which contributed to form the other great painters of that illustrious age. He saw none of the statues of ancient Greece or Rome; nor any of the works of the established schools of Rome and Venice. But Nature was his guide; and Corregio was one of her favourite pupils. To express the facility with which he painted, he used to say that he always had his thoughts ready at the end of his pencil.

The agreeable smile, and the profusion of graces, which he gave to his madonas, saints, and children, have been taxed with being sometimes unnatural; but still they are amiable and seducing: An easy and flowing pencil, an union and harmony of colours, and a perfect intelligence of light and shade, give an astonishing relief to all his pictures, and have been the admiration both of his cotemporaries and his successors. Annibal Caracci, who flourished 50 years after him, studied and adopted his manner in preference to that of any other master. In a letter to his cousin Louis, he expressed with great warmth the impression which was made on him by the first sight of Corregio's paintings: "Every thing which I see here (says he) astonishes me; particularly the colouring and the beauty of the children. They live—they breathe—They smile with so much grace and so much reality, that it is impossible to refrain from smiling and partaking of their enjoyment. My heart is ready to break with grief when I think on the unhappy fate of poor Corregio—that so wonderful a man (if he ought not rather to be called an angel) should finish his days so miserably, in a country where his talents were never known!"——

From want of curiosity or of resolution, or from want of patronage, Corregio never visited Rome, but remained his whole life at Parma, where the art of painting was little esteemed, and of consequence poorly rewarded. This concurrence of unfavourable circumstances occasioned at last his premature death at the age of 40. He was employed to paint the cupola of the cathedral at Parma, the subject of which is an assumption of the Virgin: and having executed it in a manner that has long been the admiration of every person of good taste, for the grandeur of design, and especially for the boldness of the fore-shortenings (an art which he first and at once brought to the utmost perfection), he went to receive his payment. The canons of the church, either through ignorance or baseness, found fault with his work; and although the price originally agreed upon had been very moderate, they alleged that it was far above the merit of the artist, and forced him to accept of the paltry sum of 200 livres; which, to add to the indignity, they paid him in copper money. To carry home this unworthy load to his indigent wife and children, poor Corregio had to travel six or eight miles from Parma. The weight

of

Allegri.

of his burden, the heat of the weather, and his chagrin at this villanous treatment, immediately threw him into a pleurify, which in three days put an end to his life and his misfortunes.

For the prefervation of this magnificent work the world is indebted to Titian. As he paffed through Parma, in the *fuite* of Charles V. he run inftantly to fee the *chef d'œuvre* of Corregio. While he was attentively viewing it, one of the principal canons of the church told him that fuch a grotefque performance did not merit his notice, and that they intended foon to have the whole defaced. "Have a care of what you do, (replied the other), If I were not Titian, I would certainly wifh to be Corregio."

Corregio's exclamation upon viewing a picture by Raphael is well known. Having long been accuftomed to hear the moft unbounded applaufe beftowed on the works of that divine painter, he by degrees became lefs defirous than afraid of feeing any of them. One, however, he at laft had occafion to fee. He examined it attentively for fome minutes in profound filence; and then with an air of fatisfaction exclaimed, *I am ftill a painter.* Julio Romano, on feeing fome of Corregio's pictures at Parma, declared they were fuperior to any thing in painting he had yet beheld. One of thefe no doubt would be the famous Virgin and Child, with Mary Magdalen and St Jerome: but whether our readers are to depend upon his opinion, or upon that of Lady Millar, who in her *Letters from Italy* gives a very unfavourable account of it, we fhall not prefume to determine. This lady, however, fpeaks in a very different ftyle of the no lefs famous *Notte* or Night of Corregio, of which fhe faw only a copy in the Duke's palace at Modena, the original having been fold for a great fum of money to the king of Poland. "It furprifes me very much (fays fhe), to fee how different the characters are in this picture from that which I already have defcribed to you. The fubject is a Nativity; and the extraordinary beauty of this picture proceeds from the *clair obfcure*: there are two different lights introduced, by means of which the perfonages are vifible; namely, the light proceeding from the body of the child, and the moon light. Thefe two are preferved diftinct, and produce a moft wonderful effect. The child's body is fo luminous, that the fuperficies is nearly tranfparent, and the rays of light emitted by it are verified in the effect they produce upon the furrounding objects. They are not rays diftinct and feparate, like thofe round the face of a fun that indicates an infurance office; nor linear, like thofe proceeding from the man in the almanack; but of a dazzling brightnefs: by their light you fee clearly the face, neck, and hands, of the Virgin (the reft of the perfon being in ftrong fhadow), the faces of the *paftori* who crowd round the child, and particularly one woman, who holds her hand before her face, left her eyes fhould be fo dazzled as to prevent her from beholding the infant. This is a beautiful natural action, and is moft ingenioufly introduced. The ftraw on which the child is laid appears gilt, from the light of his body fhining on it. The moon lights up the back ground of the picture, which reprefents a landfcape. Every object is diftinct, as in a bright moonlight night; and there cannot be two lights in nature more different than thofe which appear in the fame picture. The virgin and the child are of the moft perfect beauty. There is a great variety of character in the different perfons prefent, yet that uniformity common to all herdfmen and peafants. In fhort, this copy is fo admirable, that I was quite forry to be obliged to lofe fight of it fo foon; but I never fhall forget it. The duke of Modena, for whom Corregio did the original picture, gave him only 600 livres of France for it; a great fum in thofe days: but at prefent, what ought it to coft?" This great painter's death happened in 1534.

Allegri, Allegro.

ALLEGRI, Gregorio, an ecclefiaftic by profeffion, and a celebrated compofer of mufic of the 17th century, was a native of Rome. He was the difciple of Nanini, the intimate friend and contemporary of Paleftrina. His abilities as a finger were not remarkable, but he was deemed an excellent mafter of harmony; and fo much refpected by all the mufical profeffors of his time, that the pope, in the year 1629, appointed him to be one of the fingers of his chapel. To his uncommon merit as a compofer of church mufic, he united an excellent moral character, exhibiting in his actions the devotion and benevolence of his heart. The poor crowded daily to his door, whom he relieved to the utmoft of his ability; and not content with thefe beneficent actions, he daily vifited the prifons of Rome, in order to relieve the moft deferving and afflicted objects which were immured in thefe dreary manfions. With fuch divine fimplicity and purity of harmony, did he compofe many parts of the church fervice, that his lofs was feverely felt and fincerely lamented by the whole college of fingers in the papal fervice. He died Feb. 18. 1652, and was interred in the Chiefa Nuova, in a vault deftined for the reception of deceafed fingers in the pope's chapel, before the chapel of S. Filippo Neri, near the altar of annunciation.

Among his other mufical works preferved in the pontifical chapel, is the celebrated *miferere*, which, for 170 years, has been annually performed at that chapel on Wednefday and Good Friday, in Paffion-week, by the choral band, and the beft fingers in Italy. It is, however, generally believed, that it owes its reputation more to the manner in which it is performed, than to the compofition itfelf. The beauty and effect of the mufic is not difcernible upon paper, but the fingers have, by tradition, certain cuftoms, expreffions, and graces of convention, which produce wonderful effects. Some of the effects produced may be juftly attributed to the time, the place, and the folemnity of the ceremonials obferved during the performance. "The pope and conclave are all proftrated on the ground, the candles of the chapel and the torches of the balluftrade are extinguifhed one by one, and the laft verfe of this pfalm is terminated by two choirs; the *maeftra di capello* beating time flower and flower, and the fingers diminifhing, or rather extinguifhing the harmony by little and little, to a perfect point." Padre Martini fays, that there were never more than three copies made by authority, "one of which was for the emperor Leopold, one for the late king of Portugal, and the other for himfelf; but a very complete one was prefented by the pope himfelf to King George III. as an ineftimable curiofity." (*Gen. Biog.*)

ALLEGRO, in *Mufic*, an Italian word, denoting that

that the part is to be played in a ſprightly, briſk, lively, and gay manner.

Piu Allegro, ſignifies, that the part it is joined to ſhould be ſung or played quicker; as

Pocu piu Allegro intimates, that the part to which it refers ought to be played or ſung only a little more briſkly than allegro alone requires.

ALLEIN, Joseph, the ſon of Tobias Allein, was born in the Devizes, in Wiltſhire, in 1633, and educated at Oxford. In 1655, he became aſſiſtant to Mr Newton, in Taunton Magdalen, in Somerſetſhire; but was deprived for nonconformity. He died in 1668, aged 35. He was a man of great learning, and greater charity; preſerving, though a nonconformiſt, and a ſevere ſufferer on that account, great reſpect for the church, and loyalty to his ſovereign. He wrote ſeveral books of piety, which are highly eſteemed; but his *Alarm to unconverted ſinners* is more famous than the reſt. There have been many editions of this little pious work, the ſale of which has been very great; of the edition 1672, there were 20,000 ſold; of that of 1675, with this title, *A ſure guide to heaven*, 50,000. There was alſo a large impreſſion of it with its firſt title, in 1720.

Allein, *Richard*, an Engliſh nonconformiſt divine, a native of Ditchet, in Somerſetſhire, was born in the year 1611. His father was rector of Ditchet, and conducted the education of his ſon, until he was prepared for the univerſity. There he ſoon obtained the degree of maſter of arts, and after he entered into holy orders, firſt as an aſſiſtant to his father, and afterwards as rector of Batcomb, in Somerſetſhire, he diſcharged the duties of a clergyman with great induſtry and ſingular fidelity. From his education, he conceived an early predilection for the ſentiments of the Puritans, and conſequently, in the conteſt between Charles I. and the parliament, he firmly adhered to the latter. Having adopted theſe ſentiments, he ſometimes received a little diſturbance from the king's forces, but he never carried his oppoſition to any undue length. He, along with ſeveral others, ſigned a paper, entitled "The Teſtimony of the Miniſters of Somerſetſhire to the truth of Chriſt," in which their declared principles and becoming candour were amply diſplayed. Along with his father, he was employed by the commiſſioners appointed by parliament for ejecting ſcandalous miniſters; a commiſſion which was executed with rigour, and originated in intolerance.

Upon the Reſtoration he manifeſted a diſpoſition to loyalty, but unable with a good conſcience to unite in the act of conformity, he reſigned his living after enjoying it for 20 years, and ranked with the meritorious band of ſufferers, to the number of 2000, commonly denominated the *ejected miniſters*. In the houſe of Mr More who had been a member of the parliament, he exerciſed the duties of his miniſterial office under the penalties of that act, and was conſequently reprimanded by the magiſtrates and impriſoned; but his piety and exemplary conduct, procured him a mitigation of puniſhment. But no dangers could deter him from duty; for although conſtrained to remove from that place in conſequence of the "five-mile act," he continued in the diſcharge of his miniſterial office at Frome-Selwood. Here he remained until he terminated his labours by death, in 1681.

Piety, boldneſs, activity, and candour, ſhone in the character of Richard Allein. He was admired as a pathetic and practical preacher, and juſtly reſpected for the diligence with which he diſcharged the public and private duties of his profeſſion. Mr Jenkins, the vicar of the pariſh where he reſided, preached his funeral ſermon, and bore an honourable teſtimony to his activity, moderation, and piety. Richard Allein, ſimilar to his nonconformiſt brethren, chiefly confined his ſtudies and publications to ſubjects of religion. His works are ſtrongly marked with the peculiar features of the religious character then prevalent among the nonconformiſts. They have been frequently reprinted, and very much peruſed. His moſt celebrated work is "*Vindiciæ Pietatis*, or a Vindication of Godlineſs in its greateſt Strictneſs and Spirituality, with directions for a godly life;" this book was publiſhed in 1665, without a printer's name; and being unlicenſed, the copies of it were ſeized and ſent to the king's kitchen for waſte paper. The other productions of his pen are, "Heaven opened, or a brief and plain diſcovery of the riches of God's Covenant of Grace;" printed in 1665. "The World Conquered;" publiſhed in 8vo, in 1688. "Godly Fear," printed in 8vo, in 1674. "A Rebuke to Backſliders, and a Spur for Loiterers," printed in 8vo in 1677. "A Companion for Prayer;" in 12mo, 1680. "A brief character of Mr Joſeph Allein;" and "Inſtructions about heart-work, what is to be done on God's part and ours for the cure and keeping of the heart;" a poſthumous piece publiſhed in 8vo, by Dr Anneſley in the year 1681. *(Gen. Biog.)*

ALLELUIAH, or Halleluiah, a word ſignifying, *praiſe the Lord*, to be met with either at the beginning or end of ſome pſalms: ſuch as pſalm cxlv. and thoſe that follow to the end. Alleluiah was ſung upon ſolemn days of rejoicing, Tobit. xiii. 12. St John in the Revelation (xix. 1, 3, 4, 6.) ſays, that he "heard a great voice of much people in heaven, who ſaid, Alleluiah; and the four and twenty elders, and the four beaſts, fell down and worſhipped God that ſat on the throne, ſaying, *Alleluiah*." This hymn of joy and praiſes was transferred from the ſynagogue to the church. St Jerome tells us, that at the funeral of Fabiola ſeveral pſalms were ſung with loud alleluiahs; and that the monks of Paleſtine were awakened at their midnight watchings, with the ſinging of alleluiahs. So much energy has been obſerved in this term, that the ancient church thought proper to preſerve it, without tranſlating it either into Greek or Latin, for fear of impairing the genius and ſoftneſs of it. The fourth council of Toledo has prohibited the uſe of it in times of Lent, or other days of faſting, and in the ceremonies of mourning: and, according to the preſent practice of the Romiſh church, this word is never repeated in Lent, nor in the obſequies of the dead; notwithſtanding which, it is uſed in the maſs for the dead, according to the Moſarabic ritual, at the introit, when they ſing, *Tu es portio mea, Domine, Alleluiah, in terra viventium, Alleluia, Alleluia.* The ſinging alleluiah was oftentimes an invitatory or call to each other to praiſe the Lord.

ALLEMAENGEL, a ſmall Moravian ſettlement on Swetara river, in Pennſylvania.

ALLEMAND, a ſort of grave ſolemn muſic, with good

good meaſure, and a ſlow movement. It is alſo a briſk kind of dance, very common in Germany and Switzerland.

Allemand, a river which falls into the Miſſiſſippi from the ſouth-eaſt, about 43 miles ſouth of the Natches.

ALLEMANNIC, in a general ſenſe, denotes any thing belonging to the ancient Germans. Thus, we meet with Allemannic hiſtory, Allemannic language, Allemannic law, &c.

ALLEN, John, archbiſhop of Dublin in the reign of King Henry VIII. was educated in the univerſity of Oxford; from whence removing to Cambridge, he there took the degree of bachelor of laws. He was ſent by Dr Warham, archbiſhop of Canterbury, to the pope, about certain matters relating to the church. He continued at Rome nine years; and was created doctor of laws, either there or in ſome other univerſity of Italy. After his return, he was appointed chaplain to Cardinal Wolſey, and was commiſſary or judge of his court as legate *à latere*: in the execution of which office he was ſuſpected of great diſhoneſty, and even perjury. He aſſiſted the cardinal in viſiting, and afterwards ſuppreſſing, 40 of the ſmaller monaſteries, for the erection of his college at Oxford and that at Ipſwich. The cardinal procured for him the living of Dalby in Leiceſterſhire, though it belonged to the maſter and brethren of the hoſpital of Burton-Lazars. About the latter end of the year 1525 he was incorporated doctor of laws in the univerſity of Oxford. On the 13th of March 1528 he was conſecrated archbiſhop of Dublin, in the room of Dr Hugh Inge deceaſed; and about the ſame time was made chancellor of Ireland. He wrote, 1. *Epiſtola de Pallii ſignificatione activa et paſſiva*; penned by him at the time when he received the archiepiſcopal pall. 2. *De conſuetudinibus ac ſtatutis in tuitoriis cauſis obſervandis.* He wrote alſo ſeveral other pieces relating to the church. His death, which happened in July 1534, was very tragical: for being taken in a time of rebellion by Thomas Fitzgerald, eldeſt ſon to the earl of Kildare, he was by his command moſt cruelly murdered, being brained like an ox, at Tartaine in Ireland, in the 58th year of his age. The place where the murder was committed was afterwards hedged in, overgrown, and unfrequented, in deteſtation of the fact.

Allen, *Thomas*, a famous mathematician of the 16th century, born at Utoxeter in Staffordſhire the 21ſt of December 1542. He was admitted ſcholar of Trinity college, Oxford, the 4th of June 1561; and in 1567 took his degree of maſter of arts. In 1570 he quitted his college and fellowſhip, and retired to Glouceſter-hall; where he ſtudied very cloſely, and became famous for his knowledge in antiquity, philoſophy, and mathematics. Having received an invitation from Henry earl of Northumberland, a great friend and patron of the mathematicians, he ſpent ſome time at the earl's houſe, where he became acquainted with thoſe celebrated mathematicians Thomas Harriot, John Dee, Walter Warner, and Nathaniel Torporley. Robert earl of Leiceſter had a particular eſteem for Mr Allen, and would have conferred a biſhopric upon him, but his love of ſolitude and retirement made him decline the offer. His great ſkill in the mathematics made the ignorant and vulgar look upon him as a magician or conjuror: the author of a book entitled *Leiceſter's Commonwealth*, has accordingly accuſed him with uſing the art of figuring, to procure the earl of Leiceſter's unlawful deſigns, and endeavouring by the black art to bring about a match betwixt him and Queen Elizabeth. But without pretending to point out the abſurdity of the charge, it is certain that the earl placed ſuch confidence in Allen, that nothing material in the ſtate was tranſacted without his knowledge; and the earl had conſtant information, by letter from Mr Allen, of what paſſed in the univerſity. Mr Allen was very curious and indefatigable in collecting ſcattered manuſcripts relating to hiſtory, antiquity, aſtronomy, philoſophy, and mathematics: theſe collections have been quoted by ſeveral learned authors, &c. and mentioned to have been in the Bibliotheca Alleniana. He publiſhed in Latin the ſecond and third books of Claudius Ptolemy of Peluſium, *Concerning the Judgment of the Stars*, or, as it is commonly called, of the *Quadripartite Conſtruction*, with an expoſition. He wrote alſo notes on many of Lilly's books, and ſome on John Bale's work *De Scriptoribus M. Britanniæ*. Having lived to a great age, he died at Glouceſter-hall on the 30th September 1632.

ALLENDORF, a ſmall town in the circle of the Upper Rhine, and in the landgravate of Heſſe Caſſel, remarkable for its ſalt works and three ſtone-bridges. It is ſeated on the river Weſer, 15 miles eaſt of Caſſel. E. Long. 10. 5. N. Lat. 51. 26.

ALLENSTOWN, a town in New Jerſey, in Monmouth county, 15 miles north-eaſt from Burlington, and 13 ſouth-by-eaſt from Princeton.

Allenstown, a townſhip in Rockingham county, New Hampſhire, containing 254 inhabitants; ſituated on the eaſt ſide of Merrimack river, 25 miles north-weſt of Exeter, and 40 from Portſmouth.

ALLENTOWN, in Pennſylvania, Northampton county, on the point of land formed by Jordan's creek, and the Little Leheigh. It contains about 90 houſes, and an academy.

ALLER, a river which runs through the duchy of Lunenburg, and falls into the Weſer a little below Verden.

Aller, *good*, in our *Ancient Writers*. The word *aller* ſerves to make the expreſſion of ſuperlative ſignification. So, *aller-good* is the greateſt good. Sometimes it is written *alder*.

ALLERION, or Alerion, in *Heraldry*, a ſort of eagle without beak or feet, having nothing perfect but the wings. They differ from martlets by having their wings expanded, whereas thoſe of the martlets are cloſe; and denote imperialiſts vanquiſhed and diſarmed: for which reaſon they are more common in French than in German coats of arms.

ALLESTRY, Richard, D. D. was born at Uppington in Shropſhire, in 1619, was educated in the grammar ſchool of Coventry, and afterwards at Chriſt-church in Oxford. His natural talents, which were uncommonly vigorous, he carefully improved by an unwearied application to ſtudy. Accordingly, his promotion was rapid. Firſt he obtained the degree of bachelor of arts; next he was choſen moderator in philoſophy; then made a canon of Chriſt-church, created doctor of divinity, appointed chaplain in ordinary to the king, and afterwards regius profeſſor of divinity.

But in the early part of life his ſtudies were interrupted

rupted, and he was called to military fervice by hoftile occurrences of the times. In the year 1641, he, along with many other ftudents of Oxford, entered the royal fervice, and gave eminent proofs of their courage and loyal attachment. A fhort interval of hoftilities permitted them to return to their literary purfuits; but a republican party foon after difturbed their repofe, and entering Oxford, attempted to plunder the colleges. Having entered the treafury, and finding nothing but fourpence and a halter, they haftened to the deanery, and feizing many valuable articles, they locked them in an apartment, intending next day to carry them along with them. During the night, however, Alleftry having a key to that apartment, found means to remove the whole of the articles. Informed that he was the caufe of their difappointment, they feized him; and had they not been unexpectedly called off by an order of the earl of Effex, they would have feverely wrecked their indignation upon him. In October following he again took up arms, was prefent at the battle of Keinton-field, and on his way to Oxford to prepare for the reception of the king he was taken prifoner, but foon afterwards releafed by the king's forces.

A violent difeafe which then prevailed in the garrifon of Oxford, brought Alleftry to the brink of the grave; but recovering, he again joined a regiment of volunteers, chiefly confifting of Oxford ftudents. Here he ferved as a common foldier, and was often feen with the mufket in one hand and the book in the other. When the republican party prevailed, he returned at the termination of the war to his favourite ftudies, but ftill continued true to that fide of politics which he had adopted. This conduct occafioned his expulfion from the college; but he was provided with a comfortable retreat, in the families of the honourable Francis Newport, and Sir Anthony Cope.

Such was the confidence repofed in him, that, when the friends of Charles II. were fecretly preparing the way for his reftoration, they entrufted him with perfonal meffages to the king. In returning from one of thefe interviews, he was feized at Dover, and upon examination committed a prifoner to Lambeth-houfe. The earl of Shaftefbury obtained his releafe in a few weeks. Returning to vifit his friends, and among others the learned Dr Hammond, he met his corpfe at the gate of his houfe, carrying to the grave. This deeply afflicted his mind, and added much to his prefent diftreffes. The Doctor left him his valuable library, affigning as a reafon that "he well knew that his books in his hands would be ufeful weapons, for the defence of that caufe he had fo vigoroufly fupported." This valuable library along with his own, Alleftry bequeathed at his death to the univerfity.

During his life he erected at his own private expence the weft fide of the outward court of Eton college, the grammar fchool in Chrift-church college, and fettled feveral liberal penfions upon individual perfons and families. His original biographer gives him the following character. "Memory, fancy, judgment, elocution, great modefty, and no lefs affurance, a comprehenfion of things, and a fluency of words; an aptnefs for the pleafant, and fufficiency for the rugged parts of knowlege; a courage to encounter and an induftry to mafter all things, make up the character of his happy genius. There was not in the world a man of clearer honefty and courage; no temptation could bribe him to do a bafe thing, or terror affright him from the doing a good one. This made his friendfhip as lafting and inviolable as his life, without the mean confiderations of profit, or fly referves of craft; without the pageantry of ceremonious addrefs, the cold civility of fome, and the fervile falfenefs and obfequious flattery of others." He left a volume of fermons printed at Oxford in 1684, from the perufal of which pofterity may judge of his literary abilities. Although his lectures gave univerfal fatisfaction, yet he prohibited their publication.

Allestry, *Jacob*, an Englifh poet of the laft century. He was the fon of James Alleftry, a bookfeller of London who was ruined by the great fire in 1666. Jacob was educated at Weftminfter fchool, entered at Chrift-church, Oxford, in the act-term 1671, at the age of 18, and was elected ftudent in 1672. He took the degree of arts; was mufic reader in 1679, and terræ filius in 1681; both which offices he executed with great applaufe, being efteemed a good philologift and poet. He had a chief hand in the verfes and paftorals fpoken in the theatre at Oxford May 21. 1681, by Mr William Saville fecond fon of the marquis of Halifax, and George Cholmondely fecond fon of Robert Vifcount Kells (both of Chrift-church), before James duke of York, his duchefs, and the lady Anne; which verfes and paftorals, were afterwards printed in the "Examen Poeticum." He died October 15. 1686, and was buried in St Thomas's churchyard.

ALLEVEURE, a fmall brafs Swedifh coin, worth about ½d. Englifh money.

ALLEVIATION, denotes the making a thing lighter, and eafier to bear or endure. It ftands oppofed to *aggravation*.

ALLEY, William, bifhop of Exeter in the reign of Queen Elizabeth, was born at Great Wycomb in Buckinghamfhire. From Eton fchool, in the year 1528, he removed to King's college, Cambridge, where he took the degree of bachelor of arts. He alfo ftudied fome time at Oxford; afterwards he married, was prefented to a living, and became a zealous reformer. Upon Queen Mary's acceffion he left his cure and retired into the north of England; where he maintained his wife and himfelf by teaching a fchool, and practifing phyfic. Queen Elizabeth afcending the throne, he went to London, where he acquired great reputation by reading the divinity lecture at St Paul's, and in July 1560 was confecrated bifhop of Exeter. He was created doctor of divinity at Oxford in November 1561. He died on the 15th of April 1570, and was buried at Exeter in the cathedral. He wrote, 1. The Poor Man's Library, 2 vols. fol. Lond. 1571. Thefe volumes contain twelve lectures on the firft epiftle of St Peter, read at St Paul's. 2. A Hebrew Grammar. Whether it was ever publifhed is uncertain. He tranflated the Pentateuch, in the verfion of the Bible which was undertaken by Queen Elizabeth's command.

Alley, in *Gardening*, a ftraight parallel walk, bounded on both fides with trees, fhrubs, &c. and ufually covered with gravel or turf.

Alley, among *Builders*, denotes a narrow paffage leading from one place to another.

Alley, in *Perfpective*, that which, in order to have a

Alley, Alleyn. a greater appearance of length, is made wider at the entrance than at the termination.

Alley, in the *New Husbandry*, implies the vacant ſpace between the outermoſt row of corn on one bed and the neareſt row to it on the next parallel bed; and it is uſually about four feet in breadth, excluſive of the partitions between the rows of corn in the beds. The firſt hoeing of wheat is performed in the beginning of winter, and the earth is ploughed away from the rows into the intervals, which forms ſmall ridges in the middle between the double rows. The ſecond hoeing is in the ſpring, which turns it back to the rows, leaving a furrow in the middle of the alley. The third hoeing is from the rows, after the wheat has bloſſomed: this turns the earth into the intervals, forming ſmall ridges there, as at the firſt hoeing. The fourth hoeing returns the earth to the ridges, which is performed a month or more after the third hoeing. This commonly finiſhes the horſe-hoeings, if the land is in good heart; otherwiſe one or two more hoeings are neceſſary.

ALLEYN, Edward, a celebrated Engliſh actor in the reigns of Queen Elizabeth and King James, and founder of the college at Dulwich in Surry, was born at London in the pariſh of St Botolph, Sept. 1. 1566, as appears from a memorandum of his own writing. Dr Fuller ſays, that he was bred a ſtage-player; and that his father would have given him a liberal education, but that he was not turned for a ſerious courſe of life. He was, however, a youth of an excellent capacity, a cheerful temper, a tenacious memory, a ſweet elocution, and in his perſon of a ſtately port and aſpect: all which advantages might well induce a young man to take to the theatrical profeſſion. By ſeveral authorities we find he muſt have been on the ſtage ſome time before 1592; for at this time he was in high favour with the town, and greatly applauded by the beſt judges, particularly by Ben Johnſon,

Haywood, in his prologue to Marloe's Jew of Malta, calls him Proteus for ſhapes, and Roſcius for a tongue. He uſually played the capital parts, and was one of the original actors in Shakeſpeare's plays; in ſome of Ben Johnſon's he was alſo a principal performer: but what characters he perſonated in either of theſe poets, it is difficult now to determine. This is owing to the inaccuracy of their editors, who did not print the names of the players oppoſite to the characters they performed, as the modern cuſtom is; but gave one general liſt of actors to the whole ſet of plays, as in the old folio edition of Shakeſpeare; or divided one from the other, ſetting the dramatis perſonæ before the plays, and the catalogue of performers after them, as in Johnſon's.

It may appear ſurpriſing how one of Mr Alleyn's profeſſion ſhould be enabled to erect ſuch an edifice as Dulwich college, and liberally endow it for the maintenance of ſo many perſons. But it muſt be obſerved that he had ſome paternal fortune, which, though ſmall, might lay a foundation for his future affluence; and it is to be preſumed, that the profits he received from acting, to one of his provident and managing diſpoſition, and one who by his excellence in playing drew after him ſuch crowds of ſpectators, muſt have conſiderably improved his fortune: beſides he was not only an actor, but maſter of a playhouſe built at his own expence, by which he is ſaid to have amaſſed conſiderable wealth. He was alſo keeper of the king's wild beaſts, or maſter of the royal bear-garden, which was frequented by vaſt crowds of ſpectators; and the profits ariſing from theſe ſports are ſaid to have amounted to 500l. *per annum*. He was thrice married; and the portions of his two firſt wives, they leaving him no iſſue to inherit, might probably contribute to this benefaction. Such kind of donations have been frequently thought to proceed more from vanity and oſtentation than real piety; but this of Mr Alleyn has been aſcribed to a very ſingular cauſe, for the devil has been ſaid to be the firſt promoter of it. Mr Aubrey mentions a tradition, "that Mr Alleyn playing a demon, with ſix others, in one of Shakeſpeare's plays, was, in the midſt of the play, ſurpriſed by an apparition of the devil; which ſo worked on his fancy, that he made a vow, which he performed by building Dulwich college." He began the foundation of this college, under the direction of Inigo Jones, in 1614; and the buildings, gardens, &c. were finiſhed in 1617, in which he is ſaid to have expended about 10,000l. After the college was built, he met with ſome difficulty in obtaining a charter for ſettling his lands in mortmain: for he propoſed to endow it with 800l. *per annum*, for the maintenance of one maſter, one warden, and four fellows, three whereof were to be clergymen and the fourth a ſkilful organiſt; alſo ſix poor men and as many women, beſides twelve poor boys to be educated till the age of fourteen or ſixteen, and then put out to ſome trade or calling. The obſtruction he met with aroſe from the lord chancellor Bacon, who wiſhed King James to ſettle part of thoſe lands for the ſupport of two academical lectures; and he wrote a letter to the marquis of Buckingham, dated Auguſt 18. 1618, entreating him to uſe his intereſt with his majeſty for that purpoſe. Mr Alleyn's ſolicitation was however at laſt complied with, and he obtained the royal licenſe, giving him full power to lay his foundation, by his majeſty's letter patent, bearing date the 21ſt of June 1619; by virtue whereof he did, in the chapel of the ſaid new hoſpital at Dulwich, called *The College of God's Gift*, on the 13th of September following, publicly read and publiſh a quadripartite writing in parchment, whereby he created and eſtabliſhed the ſaid college; he then ſubſcribed it with his name, and fixed his ſeal to ſeveral parts thereof, in preſence of ſeveral honourable perſons, and ordered copies of the writings to four different pariſhes. He was himſelf the firſt maſter of his college; ſo that to make uſe of the words of Mr Haywood, one of his contemporaries, "He was ſo mingled with humility and charity, that he became his own penſioner, humbly ſubmitting himſelf to that proportion of diet and clothes which he had beſtowed on others." We have no reaſon to think he ever repented of this diſtribution of his ſubſtance; but on the contrary, that he was entirely ſatisfied, as appears from the following memorial in his own writing, found amongſt his papers: "May 26. 1620,—My wife and I acknowledged the fine at the common pleas bar, of all our lands to the college: bleſſed be God that he has given us life to do it." His wife died in the year 1623; and about two years afterwards he married Conſtance Kinchtoe, who ſurvived him, and received remarkable

remarkable proofs of his affection, if at least we may judge of it by his will, wherein he left her considerably. He died Nov. 25. 1626, in the 61st year of his age, and was buried in the chapel of his new college, where there is a tomb-stone over his grave, with an inscription. His original Diary is also there preserved.

The subjoined anecdote is entertaining in itself, and shows the high esteem in which Mr Alleyn was held as an actor: "Edward Alleyn, the Garrick of Shakespeare's time, had been on the most friendly footing with onr poet, as well as Ben Johnson. They used frequently to spend their evenings together at the sign of the Globe, somewhere near Black Friars, where the playhouse then was. The world need not be told, that the convivial hours of such a triumvirate must be pleasing as well as profitable, and may truly be said to be such pleasures as might bear the reflections of the morning. In consequence of one of these meetings, the following letter was written by G. Peele, a Fellow of Christ-church college, Oxford, and a dramatic poet, who belonged to the Club, to one Marle, an intimate of his:

'Friend Marle.

'I must desyr that my syster hyr watch, and the 'cookerie book you promysed, may be sente bye the 'man.——I never longed for thy company more than 'last night: we were all very merrye at the Globe, 'when Ned Alleyn did not scruple to affyrme plea- 'santely to thy Friende Will, that he had stolen his 'speech about thee Qualityes of an actor's excellencye 'in Hamlet hys Tragedye, from conversations many- 'fold whych had passed betweene them, and opinyons 'given by Alleyn touchinge the subjecte.——Shake- 'speare did not take this talke in good sorte; but 'Johnson put an end to the strife with wittylye re- 'markinge, *This affaire needeth no Contentione; you 'stole it from Ned, no doubte; do not marvel: Have 'you not seen him act tymes out of number?*—Believe 'me most syncerilie, yours, *G. Peele.*"

ALLIA, a river of Italy, in the Sabine territory, which running down a very steep channel from the mountains of Crustuminum, mixes with the Tiber 40 miles from Rome; famous for the great slaughter of the Romans by the Gauls, under Brennus, when 40,000 Romans were killed or put to flight; hence *Alliensis dies*, an unlucky day, (Virgil, Ovid, Lucan.) Our ancestors, says Cicero, deemed the day of the fight of *Allia* more fatal than that of taking the city.

ALLIANCE, in the *Civil and Canon Law*, the relation contracted between two persons or two families by marriage.

Alliance is also used for a treaty entered into by sovereign princes and states, for their mutual safety and defence.—In this sense, alliances may be distinguished into such as are offensive, whereby the contracting parties oblige themselves jointly to attack some other power; and into defensive ones, whereby they bind themselves to stand by and defend each other in case they are attacked by others. Alliance with the ancient Romans, though a sort of servitude, was much coveted. Ariarathes, we are told by Polybius, offered a sacrifice to the gods by way of thanksgiving for having obtained this alliance. The reason was, that thenceforwards people were sure not to receive any injuries except from them. There were different sorts of allies: some only united to them by a participation of the privileges of Romans, as the Latini and Hernici; others by their very foundation, as the colonies; others by the benefactions they received from them, as Masinissa, Eumenes, and Attalus, who owed their kingdoms to Rome; others by free treaties, which last by a long alliance became subjects, as the kings of Bithynia, Cappadocia, Egypt, and most of the cities of Greece: Lastly, Others by compulsive treaties, and the law of subjection, as Philip and Antiochus. For they never granted peace to an enemy, without making an alliance with him; that is, they never subdued any people without using it as a means of subduing others.

The forms or ceremonies of alliances have been various in different ages and countries. Among us, signing and swearing, sometimes at the altar, are the chief; anciently eating and drinking together, chiefly offering sacrifices together, were the customary rite of ratifying an alliance. Among the Jews and Chaldeans, heifers or calves; among the Greeks, bulls or goats; and among the Romans, hogs were sacrificed on this occasion. Among the ancient Arabs, alliances were confirmed by drawing blood out of the palms of the hands of the two contracting princes with a sharp stone, dipping herein a piece of their garments, and therewith smearing seven stones, at the same time invoking the gods Vrotalt and Alilat, *i. e.* according to Herodotus, Bacchus and Urania. Among the people of Colchis, the confirmation of alliances is said to be effected by one of the princes offering his wife's breasts to the other to suck, which he was obliged to do till there issued blood.

Alliance, in a figurative sense, is applied to any kind of union or connexion; thus we say, there is an alliance between the church and state.

ALLIARIA. See Erysimum, Botany *Index*.

ALLIER, in *Geography*, a river of France, which gives name to a department, has its source near Chateau Neuf de Randon, in the department of Lozere, and joins the Loire near Nevers.

Allier, a department of France, formerly the province of Bourbonnois, is bounded on the north by the departments of Saone and Loire, Nievre and Cher; on the east by those of Saone and Loire and the Loire; on the south by those of the Loire, Puy de Dome, and Creuse; and on the west by those of Creuse and Cher. It contains 1,454,341 square acres; the number of inhabitants is about 266,105; and it is divided into four communal districts. The principal town is Moulins.

ALLIGATI, in *Roman Antiquity*, the basest kind of slaves, who were usually kept fettered. The Romans had three degrees, or orders, of slaves or servants; the first employed in the management of their estates; the second in the menial or lower functions of the family; the third called *alligati*, above mentioned.

ALLIGATION, the name of a method of solving all questions that relate to the mixture of one ingredient with another. Though writers on arithmetic generally make alligation a branch of that science; yet, as it is plainly nothing more than an application of the common properties of numbers, in order to solve a few questions

Alligation.

queſtions that occur in particular branches of buſineſs, we chooſe rather to keep it diſtinct from the ſcience of arithmetic.

Alligation is generally divided into *medial* and *alternate*.

Alligation Medial, from the rates and quantities of the ſimples given, diſcovers the rate of the mixture.

Rule. As the total quantity of the ſimples,
To their price or value;
So any quantity of the mixture,
To the rate.

Examp. A grocer mixeth 30lb. of currants, at 4d. per lb. with 10lb. of other currants, at 6d. per lb.: What is the value of 1lb. of the mixture? *Anſ.* $4\frac{1}{2}$d.

lb.	d.		d.
30,	at 4	amounts to	120
10,	at 6	—— ——	60
40			180

lb. d. lb. d.
If 40 : 180 : : 1 : $4\frac{1}{2}$

Note 1. When the quantity of each ſimple is the ſame, the rate of the mixture is readily found by adding the rates of the ſimples, and dividing their ſum by the number of ſimples. Thus,

Suppoſe a grocer mixes ſeveral ſorts of ſugar, and of each an equal quantity, viz. at 50s. at 54s. and at 60s. per cwt. the rate of the mixture will be 54s. 8d. per cwt.; for

s. s. d.
50+54+60=164, and 3)164(54 8

Note 2. If it be required to increaſe or diminiſh the quantity of the mixture, ſay, As the ſum of the given quantities of the ſimples, to the ſeveral quantities given; ſo the quantity of the mixture propoſed, to the quantities of the ſimples ſought.

Note 3. If it be required to know how much of each ſimple is an aſſigned portion of the mixture, ſay, As the quantity of the mixture, to the ſeveral quantities of the ſimples given; ſo the quantity of the aſſigned portion, to the quantities of the ſimples ſought. Thus,

Suppoſe a grocer mixes 10lb. of raiſins with 30lb. of almonds and 40lb. of currants, and it be demanded how many ounces of each ſort are found in every pound or in every 16 ounces of the mixture, ſay,

oz.
80 : 10 : : 16 : 2 raiſins.
80 : 30 : : 16 : 6 almonds.
80 : 40 : : 16 : 8 currants.

Proof 16

Note 4. If the rates of two ſimples, with the total value and total quantity of the mixture, be given, the quantity of each ſimple may be found as follows: viz. Multiply the leſſer rate into the total quantity, ſubtract the product from the total value, and the remainder will be equal to the product of the exceſs of the higher rate above the lower, multiplied into the quantity of the higher-priced ſimple; and conſequently the ſaid remainder, divided by the difference of the rates, will quote the ſaid quantity. Thus,

Alligation.

Suppoſe a grocer has a mixture of 400lb. weight, that coſt him 7l. 10s. conſiſting of raiſins at 4d. per lb. and almonds at 6d. how many pounds of almonds were in the mixture?

		lb.	Rates.	
		400	6d.	
L. s. d.		4	4d.	
7 10=1800				
1600		1600d.	2d.	
				L. s.
2)200(100lb. of almonds at 6d. is				2 10
And 300lb. of raiſins at 4d. is				5 0
Total 400			Proof	7 10

Alligation Alternate, being the converſe of alligation medial, from the rates of the ſimples, and rate of the mixture given, finds the quantities of the ſimples.

Rules. I. Place the rate of the mixture on the left ſide of a brace, as the root; and on the right ſide of the brace ſet the rates of the ſeveral ſimples, under one another, as the branches. II. Link or alligate the branches, ſo as one greater and another leſs than the root may be linked or yoked together. III. Set the difference betwixt the root and the ſeveral branches right againſt their reſpective yoke-fellows. Theſe alternate differences are the quantities required. Note 1. If any branch happen to have two or more yoke-fellows, the difference betwixt the root and theſe yoke-fellows muſt be placed right againſt the ſaid branch, one after another, and added into one ſum. 2. In ſome queſtions, the branches may be alligated more ways than one: and a queſtion will always admit of ſo many anſwers as there are different ways of linking the branches.

Alligation alternate admits of three varieties, viz. 1. The queſtion may be unlimited, with reſpect both to the quantity of the ſimples and that of the mixture. 2. The queſtion may be limited to a certain quantity of one or more of the ſimples. 3. The queſtion may be limited to a certain quantity of the mixture.

Variety I. When the queſtion is unlimited, with reſpect both to the quantity of the ſimples, and that of the mixture, this is called *Alligation Simple*.

Examp. A grocer would mix ſugars at 5d. 7d. and 10d. per lb. ſo as to ſell the mixture or compound at 8d. per lb.: What quantity of each muſt he take?

			lb.
	5	2	2
8	7	2	2
	10	3,1	4

Here the rate of the mixture 8 is placed on the left ſide of the brace, as the root; and on the right ſide of the ſame brace are ſet the rates of the ſeveral ſimples, viz. 5, 7, 10, under one another, as the branches; according to Rule I.

The branch 10 being greater than the root, is alligated or linked with 7 and 5, both theſe being leſs than the root; as directed in Rule II.

The difference between the root 8 and the branch 5, viz. 3, is ſet right againſt this branch's yoke-fellow 10. The difference between 8 and 7 is likewiſe ſet right againſt

against the yoke-fellow 10. And the difference betwixt 8 and 10. viz. 2, is set right against the two yoke-fellows 7 and 5; as prescribed by Rule III.

As the branch 10 has two differences on the right, viz. 3 and 1, they are added; and the answer to the question is, that 2lb. at 5d. 2lb. at 7d. and 4lb. at 10d. will make the mixture required.

The truth and reason of the rules will appear by considering, that whatever is lost upon any one branch is gained upon its yoke-fellow. Thus in the above example by selling 4lb. of 10d. sugar at 8d. per lb. there is 8d. lost: but the like sum is gained upon its two yoke-fellows; for by selling 2lb. of 5d. sugar at 8d. per lb. there is 6d. gained; and by selling 2lb. of 7d. sugar at 8d. there is 2d. gained; and 6d. and 2d. make 8d.

Hence it follows, that the rate of the mixture must always be mean or middle with respect to the rates of the simples; that is, it must be less than the greatest, and greater than the least; otherwise a solution would be impossible. And the price of the total quantity mixed, computed at the rate of the mixture, will always be equal to the sum of the prices of the several quantities cast up at the respective rates of the simples.

Variety II. When the question is limited to a certain quantity of one or more of the simples, this is called *Alligation Partial.*

If the quantity of one the simples only be limited, alligate the branches, and take their differences, as if there had been no such limitation; and then work by the following proportion:

As the difference right against the rate of the simple, whose quantity is given,
To the other differences respectively;
So the quantity given,
To the several quantities sought.

Examp. A distiller would, with 40 gallons of brandy at 12s. per gallon, mix rum at 7s. per gallon, and gin at 4s. per gallon: How much of the rum and gin must he take, to sell the mixture at 8s. per gallon?

				Gal.	
8	12	14,	5	40 of brandy.	*Ans.*
	7	4	4	32 of rum.	
	4	4	4	32 of gin.	

The operation gives for answer, 5 gallons of brandy, 4 of rum, and 4 of gin. But the question limits the quantity of brandy to 40 gallons; therefore say,

If 5 : 4 : : 40 : 32

The quantity of gin, by the operation, being also 4, the proportion needs not be repeated.

Variety III. When the question is limited to a certain quantity of the mixture, this is called *Alligation Total.*

After linking the branches, and taking the differences, work by the proportion following:

As the sum of the differences,
To each particular difference;
So the given total of the mixture,
To the respective quantities required.

Examp. A vintner hath wine at 3s. per gallon, and would mix it with water, so as to make a composition of 144 gallons, worth 2s. 6d. per gallon: How much wine, and how much water, must he take?

			Gal.	
30	36	30	120 of wine	*Ans.*
	0	6	24 of water.	
		36	144 total.	

120 × 36 = 4320
24 × 0 = 0

Proof 144)4320(30
As 36 : 30 : : 144 : 120
As 36 : 6 : : 144 : 24.

There being here only two simples, and the total of the mixture limited, the question admits but of one answer.

ALLIGATOR, in *Zoology*, a synonyme of the lacerta crocodilus. See LACERTA.

ALLIGATOR Pear. See LAURUS, BOTANY *Index.*

ALLIONIA. See BOTANY *Index.*

ALLIOTH, a star in the tail of the Greater Bear, much used for finding the latitude at sea.

ALLITERATION, an ornament of language chiefly used in poetry, and consisting in the repetition of the same letter at certain intervals. We do not remember to have ever seen any satisfactory account of alliteration in the writings of the critics. They seem to have passed it over in contemptuous silence; either as a false refinement or as a mere trifle. It perhaps deserves a better fate. Many chapters have been composed on quantity, on the expression resulting from different arrangements of long and short syllables, and on the powers of pauses as they are variously placed, without a word of alliteration. This is the more extraordinary, as one should think it impossible for any man to examine minutely, and, as it were, dissect a number of verses, without perceiving the vast abundance of this ornament. It is as if an anatomist should publish a complete table of the arteries in the human body, and affect never to have seen a vein or a nerve: for it may be affirmed, with small danger of mistake, that if you examine any number of verses, remarkable either for sweetness or for energy, they will be found in some degree alliterative. We do not pretend to say, that the sweetness and energy of versification depends chiefly on this circumstance, yet we cannot help believing that it may claim some share: for it is a constant appearance, as far as we have ever observed, that the poets whose fame is highest for versification, have been attentive to alliteration.

The very trifling appearance of the ornament itself, upon a superficial view, and the frequent abuse of it, are circumstances indeed which give no encouragement to a serious inquiry into its nature and operation. How common is it for writers, who affect to be comic, when in want of other means for raising a smile, to use affected alliteration with success? But, in the fine arts, no beauty or grace is beyond the power of ridicule. The noblest attitudes in painting have been rendered laughable by caricatura. St Paul preaching at Athens, in the design of Raphael, appears elegant, noble, and in some degree awful. The same apostle, represented by Hogarth in nearly the same attitude, pleading before

fore the governor Felix, ſeems altogether ridiculous. So the language and verſification of Milton in the Paradiſe Loſt appear only proper for the moſt elevated ſubjects. In the Splendid Shilling of Philips, they appear equally proper for the loweſt. So fares it alſo with alliteration. Nor ought we to be mortified at the diſcovery, that much of the delight afforded by verſification ariſes from a cauſe ſo pitiful as the repetition of the ſame letter twice, or oftener, on the accented parts of a verſe; for there are many other cauſes of pleaſure, which, when thus detected and taken to pieces, ſeem equally contemptible.

We apprehend the principal operation of this ornament to be quite mechanical. It is eaſier for the organs of ſpeech to reſume, at ſhort intervals, one certain conformation, than to throw themſelves into a number of different ones, unconnected and diſcordant. For example, a ſucceſſion of labials, interſperſed at regular diſtances with dentals and gutturals, will be more eaſily pronounced than the ſucceſſion of all the three at random. Sounds of which the articulation is eaſieſt, are moſt completely in the power of the ſpeaker. He can pronounce them ſlowly or rapidly, ſoftly or with force, at pleaſure. In this we imagine the power and advantage of alliteration are founded; for we would not lay any ſtreſs on the pleaſure which can reſult to the ear from the repetition of the ſame letter. It has been compared to the frequent returns of the key-note in a muſical ſtrain; but that analogy is extremely faint. The ear, we preſume, can be pleaſed with alliteration only in ſo far as it contributes to the ſuperior eaſineſs of recitation; for what is recited with eaſe muſt be heard with pleaſure.

Theſe remarks might be confirmed and illuſtrated by numberleſs paſſages from the beſt poets. Some few lines will ſuffice, taken from Gray, who ſeems to have paid particular attention to this grace. He profeſſed to have learned his verſification from Dryden, as Dryden did from Spenſer; and theſe three abound in alliteration above all the Engliſh poets. We chooſe Gray for another reaſon, in proof of what we mentioned before, that alliteration contributes not only to the *ſweetneſs*, but alſo to the *energy*, of verſification; for he uſes it chiefly when he aims at ſtrength and boldneſs. In the *Siſter Odes* (as Dr Johnſon ſtyles them), almoſt every ſtrophe commences and concludes with an alliterative line. The poet, we ſuppoſe, wiſhed to begin with force, and end with dignity.

"*R*uin ſeize thee, *r*uthleſs king."
"To *h*igh-born *H*oel's *h*arp, or ſoft *L*lewe*l*lyn's *l*ay."
"*W*eave the *w*arp, and *w*eave the *w*oof."
"Stamp we our vengeance *d*eep, and ratify his *d*oom."
"Regardleſs of the *ſ*weeping whirlwind's *ſ*way."
"That huſh'd in grim re*p*oſe, ex*p*ects his ev'ning *p*rey."

It muſt be obſerved here, that we hold a verſe alliterative which has a letter repeated on its accented parts, although thoſe parts do not begin words; the repeated letter bearing a ſtrong analogy to the bars in a muſical phraſe. Gray ſeems to have had a particular liking to theſe ſort of balanced verſes, which divide equally, and of which the oppoſite ſides have an alliterative reſemblance.

"Eyes that *g*low, and fangs that *g*rin."
"Thoughts that *b*reathe, and words that *b*urn."
"*H*auberk craſh, and *h*elmet ring."

All theſe lines appear to us to have a force and energy, ariſing from alliteration, which renders them eaſy to be recited; or, if the reader pleaſes, *mouthed*. For the ſame reaſon the following paſſage appears ſad and ſolemn, by the repetition of the labial liquid.

"*M*ountains, ye *m*ourn in vain,"
"*M*odred, whoſe *m*agic ſong,"—&c.

If alliteration thus contributes to enforce the expreſſion of a poetical ſentiment, its advantages in poetry muſt be conſiderable. It is not, therefore, unworthy a poet's regard in the act of compoſition. If two words offer of equal propriety, the one alliterative, the other not, we think the firſt ought to be choſen. We would compare this to the practice of fuguing in muſic. A compoſer who aims at expreſſion will not hunt after fugues; but if they offer, if they ſeem to ariſe ſpontaneouſly from the ſubject, he will not reject them. So a good poet ought not to ſelect an epithet merely for beginning with a certain letter, unleſs it ſuit his purpoſe well in every other reſpect; for the beauty of alliteration, when happy, is not greater than its deformity when affected. A couplet from Pope will exemplify both; the firſt line being bad, and the ſecond good:

"Eternal beauties grace the *ſ*hining *ſ*cene,
"*F*ields ever *f*reſh, and *g*roves for ever *g*reen."

ALLIUM (from ἀλεω, "to avoid or ſhun," becauſe many ſhun the ſmell of it), GARLIC. See BOTANY *Index*.

ALLIX, PETER, a French Proteſtant divine, was born at Alençon in France, in the year 1641. He became a learned divine of the Engliſh church, and a ſtrenuous defender of the Proteſtant faith. At the time when the edict of Nantes tolerated and protected the Proteſtants of France, he entered upon his clerical profeſſion, and remained miniſter of Rouen until the thirty-fifth year of his age. In this period he wrote ſeveral pieces upon the controverſy between the Papiſts and the Proteſtants, which obtained him great fame among his own party. He removed to Charenton in the vicinity of Paris, which was the principal church among the reformed, and frequented by perſons of the firſt rank in France, who profeſſed the Proteſtant faith. Here Allix preached a courſe of excellent ſermons in defence of the Proteſtant religion, ſome of which were afterwards printed in Holland, and added to his increaſing fame. The chief object of theſe ſermons was to repel the attack of the biſhop of Meaux, the moſt ingenious and able opponent of the Reformation at that time. The unwiſe revocation of the edict of Nantes drove Allix and many others to ſeek refuge in England. Three years after his arrival in England, he had made himſelf ſo perfectly maſter of the Engliſh language as to be able to write very correctly a "Defence of the Chriſtian Religion." This work he dedicated to James II. in teſtimony of gratitude for his kind reception of the diſtreſſed refugees of France. In juſtice to the memory of James,

 and

and as a ſpecimen of the talents of Allix, it may be proper to give an extract from this curious dedication. —"As your majeſty continues ſtill to give ſuch illuſtrious inſtances of your clemency and royal protection to thoſe of your nation; ſo I confeſs, Sir, I thought myſelf under an obligation to lay hold upon this opportunity of publiſhing what all thoſe who find ſo ſure a protection in your majeſty's dominions feel and think as much as myſelf upon theſe new teſtimonies of your royal bounty. When your majeſty had taken us into your particular care, and had granted us ſeveral privileges, and ſo made us ſharers in all the advantages which thoſe who live under your government enjoy; your majeſty did yet ſomething more, and inſpired all your ſubjects with the ſame compaſſion towards us, with which your royal breaſt was already touched. You ſaw our miſeries, and reſolved to give us eaſe; and this generous deſign was executed, and your royal clemency diffuſed in the hearts of all your ſubjects. The whole world, Sir, which has received upon all its coaſts ſome remainders of our ſhipwreck, is filled with admiration of the unexampled effects of your majeſty's clemency. I could wiſh, Sir, that this work which I now preſent to your majeſty might be ſo happy as to paſs to poſterity with this character of our acknowledgment, and that it might ſtand as a faithful record for ever to perpetuate the memory of that lively ſenſe of your bounty which is imprinted on all our hearts."

Not long after his arrival in England, he was honoured with the title of doctor of divinity, and alſo received the more ſubſtantial honour of being appointed treaſurer of the church of Saliſbury. Allix ſtill maintained the ſtation of a champion for the Proteſtant cauſe, and in oppoſition to the biſhop of Meaux, proved that the charge of hereſy juſtly belonged to the Papiſts, and not to their opponents, becauſe they had introduced new doctrines into the church.

After having with much induſtry and learning exerciſed his talents in defence of Proteſtantiſm, he employed his pen to ſupport the doctrine of the Trinity againſt the Unitarians, who contended that the idea of Chriſt's divinity could be traced up no higher than the time of Juſtin Martyr. With a great diſplay of erudition, he attempted to prove that the Trinitarian doctrine was believed by the Jewiſh church. But the reputation which he had acquired for learning and ability was ſomewhat diminiſhed by the ridicule which he brought upon himſelf in attempting to fix the preciſe time of Chriſt's ſecond coming to the year 1720, or at the very lateſt, to the year 1736. He died at London in the year 1717, after his ſtudious life had been protracted to the length of 76 years. He left behind him numerous proofs of his great talents, extenſive learning, uncommon induſtry, and zealous attachment to the doctrines of the church of England. *(Gen. Biog.)*

ALLOA, or ALLOWAY, a ſea-port town in Scotland, ſeated on the Forth, about 20 miles higher up the river than Leith, and five miles eaſt of Stirling. It is a populous place; has two market days in the week; and is remarkable for its fine caſtle, the ſeat of Mr Erſkine of Mar, and for the coal mines near it. The harbour is extremely commodious, with great depth of water; and veſſels are expeditiouſly loaded with coals from the pits by an uncommon waggon-way, on which one horſe draws with eaſe three waggons at once, each waggon containing a ton and a half. An excellent dry dock has alſo lately been erected here, capable of receiving ſhips of the greateſt burden. There is likewiſe a large glaſs-houſe for blowing bottles, of which veſſels are ſupplied with any quantity upon the the ſhorteſt notice.

The tower and lands of Alloa were exchanged by David II. king of Scots, *anno* 1365, with Thomas Lord Erſkine, for the lands and eſtate of Strathgartney in Perthſhire; and ſince that time the caſtle of Alloa has been the favourite reſidence of the family of Mar. The ſituation is uncommonly beautiful. The gardens here were the firſt that were laid out on a great ſcale in Scotland; and, with the advice of Le Nautre, were indebted to the taſte of John the late earl of Mar, who began to plant them in the year 1706. They contain about forty acres, in which there is ſome very fine timber, near a century old.

The tower of Alloa is 89 feet in height, with walls of 11 feet in thickneſs; and was built in the end of the 13th century. In this reſidence of the family of Erſkine many of the Scottiſh princes received their education, having been for more than two centuries the wards of the Lords Erſkine and Earls of Mar; who held generally the caſtle of Stirling, and frequently the three principal fortreſſes of the kingdom, Edinburgh, Stirling, and Dumbarton. The laſt heir of the Scottiſh monarchy who was nurtured there was Henry prince of Wales; whoſe cradle, golf-clubs, and other infantine and youthful remains, are preſerved by the heir of the earls of Mar, in remembrance of that ſpirited and promiſing prince; of whom Dr Birch has preſerved ſeveral anecdotes, connected with the Erſkines and his reſidence at Alloa. Among other remains of antiquity preſerved at Alloa, in remembrance of the confidence and affection which ſubſiſted always betwixt the Stuarts and the Erſkines, is the private ſignet of the unfortunate Mary, which ſhe gave to the regent Mar, after ſhe was obliged by the treaty of Edinburgh to deſiſt from wearing the arms of England in the firſt quarter; the child's chair of James VI. her ſon; and the feſtive chair of Thomas Lord Erſkine the ſecond earl of Mar of the name, with the faſhionable grace carved on it, *Soli Deo Honor et Gloria.*

ALLOBROGES (Inſcriptions, Livy, Velleius, Florus); from *Allobrox* (Horace): a people of Gallia Narbonenſis, ſituated between the rivers Iſara and Rhodanus, and the Lacus Lemanus; commended by Cicero for their fidelity; but reproached by Horace on account of their fondneſs for novelty.

Noviſque rebus infidelis Allobrox. Epod. 16.

ALLOCATION denotes the admitting or allowing of an article of an account, eſpecially in the exchequer. Hence

ALLOCATIONE Facienda, is a writ directed to the lord treaſurer, or barons of the exchequer, commanding them to allow an accountant ſuch ſums as he has lawfully expended in the execution of his office.

ALLOCUTIO, an oration or ſpeech of a general addreſſed to his ſoldiers, to animate them to fight, to appeaſe ſedition, or to keep them to their duty. A mount of earth was raiſed upon the occaſion, as it were a kind of a tribunal of turf. From this the general pronounced his harangue to the army, which was ranged

ged in several squadrons round him, with their captains at their head. When the time and circumstances would not admit of a formal harangue, the general went through the ranks, and called each by his name, putting them in mind of their courage upon former occasions, mentioning the victories they had won, and making promises of plunder.

ALLODIUM, or Alleud, denotes lands which are the absolute property of their owner, without being obliged to pay any service or acknowledgment whatever to a superior lord. See Fee and *Feodal System*.

ALLOPHYLLUS, in *Botany*. See Botany *Index*.

ALLOTTING, or *Allotment of Goods*, in matters of commerce, is when a ship's cargo is divided into several parts, bought by divers persons, whose names are written on as many pieces of paper, which are applied by an indifferent person to the several lots or parcels; by which means the goods are divided without partiality, every man having the parcel which the lot with his name appropriates.

ALLOWAY Creek, in Salem county, New-Jersey, empties into the Delaware. It is navigable 16 miles, interrupted, however, by several draw-bridges.

ALLOY, or Allay, properly signifies a proportion of a baser metal mixed with a finer one. The alloy of gold is estimated by carats, that of silver by pennyweights. In different nations different proportions of alloy are used; whence their moneys are said to be of different degrees of fineness or baseness, and are valued accordingly in foreign exchanges. The chief reasons alledged for the alloying of coin are: 1. The mixture of the metals, which, when smelted from the mine, are not perfectly pure. 2. The saving the expence it must otherwise cost if they were to be refined. 3. The necessity of rendering them harder, by mixing some parts of other metals with them, to prevent the diminution of weight by wearing in passing from hand to hand. 4. The melting of foreign gold or coin which is alloyed. 5. The charges of coinage, which must be made good by the profit arising from the money coined. 6. and lastly, The duty belonging to the sovereign, on account of the power he has to cause money to be coined in his dominions.

In a more general sense, the word is employed in chemistry to signify the union of different metallic matters.—As an infinity of different combinations may be made according to the nature, the number, and the proportions of the metallic matters capable of being alloyed, we shall not here enter into the detail of the particular alloys, all which are not yet nearly known. Those which are used, as *Bronze*, *Tombac*, *Brass*, *White Copper*, &c. may be found in the article Chemistry. and what is known concerning other alloys will be treated of along with the metals in the same article. See Chemistry *Index*.

ALLUM. See Alum.

ALLUMINOR, from the French *allumer*, "to lighten," is used for one who coloureth or painteth upon paper or parchment; and the reason is, because he gives light and ornament by his colours to the letters or other figures. Such ornaments are styled *illuminations*. The word is used in stat. 1 R. III. cap. 9. But now such a person is called a *limner*.

ALLUSH, in *Ancient Geography*. The Israelites being in the wilderness of Shur, departed from Dophkah, and went to Allush, from whence they proceeded to Rephidim; Num. xxxiii. 13, 14. Eusebius and St Jerome fix Allush in Idumea, about Gabala or Petra, the capital of Arabia Petræa. In the accounts of the empire, it is situated in the third Palestine; and by Ptolemy, among the cities of Idumæa.

ALLUSION, in *Rhetoric*, a figure by which something is applied to, or understood of, another, on account of some similitude between them.

ALLUVION, in *Law*, denotes the gradual increase of land along the sea-shore, or on banks of rivers.

ALLY, in matters of polity, a sovereign prince or state that has entered into alliance with others. See Alliance.

ALMACANTARS. See Almucantars.

ALMACARRON, a sea-port town of Spain, in the province of Murcia, at the mouth of the river Guadalantin. It is about twenty miles west of Carthagena, and is remarkable for the prodigious quantity of alum found in its territory. W. Long. 1. 15. N. Lat. 37. 40.

ALMADEN, a town of Spain, in the province of La Mancha, in the kingdom of Castile, situated upon the top of a mountain, where are the most ancient as well as the richest silver mines in Europe.

ALMADIE, a kind of canoe, or small vessel, about four fathoms long, commonly made of bark, and used by the negroes of Africa.

Almadie is also the name of a kind of long boats, fitted out at Calicut, which are eighty feet in length, and six or seven in breadth. They are exceedingly swift, and are otherwise called *cathuri*.

ALMAGEST, in *Matters of Literature*, is particularly used for a collection or book composed by Ptolemy, containing various problems of the ancients both in geometry and astronomy.

Almagest is also the title of other collections of this kind. Thus, Riccioli has published a book of astronomy, which he calls the *New Almagest*; and Plukenet, a book which he calls *Almagestum Botanicum*.

ALMAGRA, a fine deep red ochre, with some admixture of purple, very heavy, and of a dense yet friable structure, and rough dusty surface. It adheres very firmly to the tongue, melts freely and easily in the mouth, is of an austere and strongly astringent taste, and stains the skin in touching. It is the *Sil Atticum* of the ancients; it ferments very violently with acid menstruums; by which single quality, it is sufficiently distinguished from the *Sil Syricum*, to which it has in many respects a great affinity. It is found in immense quantities in many parts of Spain; and in Andalusia there are in a manner whole mountains of it. It is used in painting, and in medicine as an astringent.

ALMAGRO, a fortress of Spain, the capital of one of the districts of La Mancha. It was built by the archbishop Roderic of Toledo, who finished it in 1214, and put a considerable garrison into it to restrain the incursions of the Moors. This was hardly done, when the fortress was besieged by an army of 5000 horse and foot, under the command of a Moorish officer of great reputation; but the prelate, its founder, took care to supply those within with such plenty of necessaries, that at length the enemy found themselves obliged to raise the siege and retire with great loss.

Almagro, *Diego De*, a Spanish commander, was of

Almagro. of ſuch obſcure birth and mean parentage, that he derived his name from the village where he was born, in 1463. Deprived of the means of early inſtruction, he could neither read nor write, but nevertheleſs, in conſequence of his improvements in the military art, he formed an aſſociation with Pizarro and de Luque, for the purpoſe of diſcoveries and conqueſt upon the Peruvian coaſt. The governor of Panama having ſanctioned their enterpriſe, they devoted their united exertions to that undertaking. Pizarro directed the conqueſt, and Almagro was appointed to conduct the ſupplies, proviſions, and reinforcements. In the two firſt unſucceſsful attempts, he performed this office with perſevering fidelity and uncommon activity. His perſeverance was followed with complete ſucceſs; for they at laſt diſcovered the coaſt of Peru, and landed at Tumbez, diſtinguiſhed by its temple and palace of the incas or ſovereigns, and ſituated about three degrees ſouth of the line. Pizarro was ſent over to Spain to ſolicit farther powers, after the three adventurers had previouſly adjuſted their future preferments, and agreed that Pizarro ſhould be governor, Almagro lieutenant-governor, and Luque biſhop. In this negociation, Pizarro obtained the clerical dignity for Luque; but chiefly concerned about his own intereſt, he neglected the preferment of Almagro. On his return, Almagro was ſo enraged, that he refuſed to act with ſuch a perfidious companion, and reſolved to form a new aſſociation. Pizarro for the preſent artfully endeavoured to avert the indignation of Almagro, and gradually ſoothed the rage and diſappointment of the ſoldier. The union was renewed upon the former terms; and it was ſolemnly ſtipulated that a common expence and a common advantage ſhould take place.

In February 1531, leaving Almagro at Panama, to ſupply proviſions and reinforcements, Pizarro ſet ſail for Peru. He attacked a principal ſettlement of the natives, in the province of Coaque, obtained immenſe ſpoil, and made ſuch ample remittances to Almagro, as enabled him to complete his reinforcement, and in the cloſe of the year 1532, he arrived at St Michael with a body of men, which nearly doubled the number of thoſe which Pizarro had along with him. The Spaniards about this time took captive the unfortunate Inca Atahualpa; and after they had received an immenſe ſum for his ranſom, they barbarouſly put him to death. Pizarro ſailed for Spain with the news of their ſucceſs, and with remittances to a great amount; and conſequently Almagro gained that elevated ſtation he ſo long and eagerly deſired. But no ſooner had Almagro received the intelligence of his promotion by the royal grant, than he attempted to ſeize Cuzco, the imperial reſidence of the incas, under pretence that it lay within his deſtined territory. This produced a new quarrel; but peace was reſtored upon the determination of Almagro to attempt the conqueſt of Chili, and likewiſe to have part of the territory of Peru.

In 1535, he accordingly ſet out at the head of 570 Europeans, and in croſſing the mountains, he ſuffered great hardſhips and loſſes by miſtaking the route, but at length he deſcended into the plains of that devoted region. Here he met with a more vigorous reſiſtance from the natives than the Spaniards had ever experienced in other countries. He had, however, made ſome progreſs, when he was recalled to Peru by the news of the natives having riſen in great numbers, and attacked Lima and Cuzco. He purſued a new route, and marching through the ſandy plains on the coaſt, he ſuffered by heat and drought calamities not inferior to thoſe which he had endured from cold and famine on the ſummit of the Andes. Arriving at a favourable moment, he reſolved to hold the place both againſt the Indians and his Spaniſh rivals. He attacked the Peruvian army with great vigour, and making a great ſlaughter, he proceeded to the gates of Cuzco without any farther interruption. The open, affable, and generous temper of Almagro, gained over to his ſide many of the adherents of the Pizarros, who were diſguſted with their harſh and oppreſſive conduct. With their aid, he advanced towards the city by night, ſurpriſed the ſentinels, and ſurrounded the houſe where the two brothers reſided, who were compelled, after an obſtinate defence, to ſurrender at diſcretion. A form of government was ſettled in the name of Almagro, and his juriſdiction over Cuzco was univerſally acknowledged. This was the origin of a civil war; the beginning of which was very advantageous to Almagro, who by ſkilful manœuvres entirely routed a body of Spaniſh troops advancing to the relief of Cuzco, and made Alvarado their commander priſoner. But inſtead of improving theſe advantages, he unwiſely marched back to Cuzco, and there awaited the arrival of Pizarro. Pizarro, convinced of his own feeble reſources, propoſed an accommodation, and with his uſual art protracted the negociation until he found himſelf in a condition to meet his antagoniſt in the field of battle. Meanwhile Alvarado and one of the Pizarros, by bribing their keepers, found means to eſcape, and perſuaded 60 of the men who guarded them to attend them in their flight; and the governor releaſed the other Pizarro. When Pizarro thought himſelf ſufficiently prepared to ſettle the dominion of Peru, he marched with an army of 500 men to Cuzco. Almagro, previous to this, worn out with age and infirmity, reſigned the command to Orgognez. A fierce and bloody battle enſued, in which Almagro was made priſoner, his army defeated, and the commander wounded. About 140 ſoldiers fell in the field, and Orgognez, along with ſeveral others, was maſſacred in cold blood. During that fatal day, Almagro, placed in a litter, which was ſtationed on an eminence, beheld from thence the total defeat of his troops, and felt all the indignation of a ſoldier who had ſeldom experienced defeat. He was taken priſoner, remained ſeveral months in confinement, and afterwards was tried, and condemned to death. In the view of an ignominious death, the courage of the veteran forſook him, and he unſucceſsfully ſupplicated for life, in a manner unworthy of his former character. All the arguments he could employ were ineffectual. The Pizarros remained unmoved by all his entreaties. As ſoon, however, as Almagro ſaw that his fate was inevitable, he reſumed his courage, and exhibited all his uſual dignity and fortitude. In the year 1538, and in the 75th year of his age, he was ſtrangled in priſon, and afterwards beheaded. He left one ſon by an Indian woman of Panama; and in conſequence of a power which the emperor had granted, he declared his ſon his ſucceſſor in in the government, although he was then a prisoner in Lima.

With the qualities of intrepid valour, indefatigable activity, and insurmountable constancy, he blended the more amiable dispositions of frankness, generosity, and candour. These qualities rendered him beloved by his followers; and his misfortunes excited their sympathy and pity, so that his death was universally regretted, and particularly by the poor Indians, who deemed him their guardian and protector against the cruel and unfeeling Pizarro. Upon the whole review of his character, it appears just to conclude, that he was, although of inferior abilities, a more amiable man than his rival. (*Gen. Biog.*)

ALMAGRO the Younger, by his courage, generosity, and other accomplishments, was placed at the head of the party after the death of his father. The father, conscious of his own inferiority from the total want of education, used every possible mean to improve the mind and embellish the manners of his son; so that he soon acquired those accomplishments which rendered him respected by illiterate adventurers, who cheerfully ranged around his standard; and, by his dexterity and skill, sought deliverance from the oppressions of Pizarro. Juan de Herrada, an officer of great abilities, continued still to direct his counsels and to regulate his enterprises; and, while Pizarro confided in his own security, a conspiracy was formed against him, which terminated in his death. The assassins, exulting in their success, and waving their bloody swords, hastened to the street, proclaimed the death of the tyrant, and compelled the magistrates and principal citizens of Lima to acknowledge Almagro as lawful successor to his father. But his reign was of short duration; for, in 1541, Vaca de Castro, arriving at Quito, produced the royal commission, appointing him governor of Peru, together with all the privileges and authority of Pizarro. The talents and influence of the new governor soon overpowered the interest of Almagro, who, perceiving the rapid decline of his influence, hastened with his troops to Cuzco, where his opponents had erected the royal standard under the command of Pedro Alvarez Holguin. Herrada the guide of his counsels died during his march; and from that time his measures were conspicuous for their violence, concerted with little ingenuity, and executed with little address. On September 16. 1542 at length the forces of Almagro and Vaca de Castro met, and victory long remained doubtful; till at last it declared for the new governor. The followers of Almagro displayed uncommon valour, and Almagro conducted the military operations of that fatal day with a gallant spirit, worthy of a better cause and deserving of a better fate. In proportion to the number of combatants the carnage was very great. Of 1500 men 500 fell in the field, and many more were wounded. Almagro escaped, but being betrayed by some of his own officers, he was publicly beheaded at Cuzco, and in him the name and spirit of the party of Almagro became extinct. (*Gen. Biog.*)

ALMAMON, or MAMON, also named *Abdallah*, caliph of Bagdad, was born A. D. 785. His elder brother Al Amin succeeded to the caliphate on the death of his father, and Almamon at that time was governor of Chorasan. As by the will of the father it was provided, that his three sons should succeed to the caliphate in order, Almamon ordered his elder brother to be proclaimed caliph throughout his government. But his brother repaid his friendship and attachment to his interest with open expressions of hatred, and unjust attempts to exclude him from the destined succession. Almamon was thus forced to consult measures for his own safety and promotion, by causing himself to be proclaimed caliph. After various struggles, his general, Thaher, in the year 813 took possession of Bagdad, pursued Al Amin to his retreat, and caused him to be assassinated, so that Almamon remained without a competitor. Various rebellions disturbed the tranquillity of the first years of his reign; but by his prudent administration and vigorous exertions, these were at length extinguished. Instigated by the advice of his vizier, he soon after raised greater commotions, and exposed his dignity to greater dangers, by countenancing the sect of Ali. He invited to court Iman Rizza, gave him his daughter in marriage, and even declared him his successor in the empire. He assumed the green turban, the colour of the house of Ali, and obliged his courtiers and soldiers to imitate his example. Alarmed at these proceedings, the orthodox Mussulmans, and the house of Abbas, excited a great revolt in Bagdad, and proclaimed Ibrahim, Almamon's uncle, caliph. A civil war was just about to commence when Fadel the vizier was assassinated and Rizza died. The people of Bagdad then deposed Ibrahim, and returned to their former allegiance. Taking the advantage of Almamon's absence, Thaher his general seized upon the government of Chorasan, where he founded a dynasty which existed during a period of 16 years.

Almamon employed the period of tranquillity that followed in the introduction and improvement of literature into his dominions, which constitutes the greatest glory of his reign. During the days of his father he discovered an ardent thirst after knowledge, by forming a college in Chorasan, adorned with the most eminent men of various countries; and appointed Mesue, a famous Christian physician of Damascus, for their president. When his father remonstrated against conferring such an honour upon a Christian, he reminded him, that the most learned men and the most skilful artists in his dominions were Jews and Christians; and added, that he had chosen Mesue as a preceptor in science and useful arts, and not as a teacher of religion. Under his auspices Bagdad became the seat of literature, of private and academical instruction, and the habitation of men of eminence from all quarters. Many valuable books in the Greek, Persian, Chaldean, and Coptic languages, among which were the works of Aristotle and Galen, were translated into the Arabic at his own expence. The caliph himself deemed it an honour to set an example to others of the becoming respect due to mental cultivation, by visiting the schools, and treating the professors with great regard. In mathematics, astronomy, and philosophy, he made a rapid and extensive progress. He was the author of astronomical tables, which on account of their accuracy have been much admired. By these various exertions the character of the Saracens was suddenly changed from a a rude and ferocious to a polite and civilized people, while the moſt powerful and extenſive of the European ſtates were involved in ignorance and barbariſm. Literature has ſuſtained ſome irreparable loſſes from his too great partiality to the Arabic writers, which induced him to deſtroy the originals of the tranſlated manuſcripts. He is repreſented by the Sonnites or orthodox Mahometans as little better than an Infidel, becauſe of his attention to philoſophy and letters. His conduct, however, ſhows that he was not ſufficiently careful to preſerve a philoſophical mean betwixt the different religious parties during the time of his adminiſtration, as he openly manifeſted a predilection to the doctrines of the Motazeli, who aſſerted the free will of man, and denied the eternity of the Koran. Some allege, that on account of the murmurs which aroſe againſt him, he was induced to exhibit too great a zeal by eſtabliſhing a kind of inquiſition, to compel all his ſubjects to profeſs Iſlamiſm. The experiment, however, ſoon terminated in the better and juſter expedient of univerſal toleration; and it is abundantly evident, that the Chriſtians in his dominions never felt the power of his inquiſition.

The public tranſactions of his reign are in themſelves important. In the year 822 he ſent a body of his troops to the aſſiſtance of Thomas, a Greek, who made war on Michael the Stammerer, the emperor of Conſtantinople, and beſieged his capital. This expedition, which on the part of the caliph ſeems to have been founded in injuſtice, proved unſucceſsful; Thomas was taken priſoner, and ſuffered death. In the years 829 and 830 he commenced open hoſtilities upon the Greeks, rendered himſelf maſter of many places, and carried devaſtation into their territories. He was ſucceſsful in ſuppreſſing a revolt in Egypt in the year 831. In this country he was led to diſcover a treaſure buried under two columns by Merwan, the laſt caliph of the houſe of Ommijah. In repairing a decayed *mikias* or meaſuring pillar, and erecting a new one for determining the gradation of the increaſe of the Nile, Almamon diſplayed his love of ſcience. In the year 833 he again viſited Egypt; on his return he penetrated into the territories of the Greek emperor, even into Cilicia. Returning home he encamped on the banks of a river, and, excited by thirſt, he drank too freely of the water; and at the ſame time indulged himſelf immoderately in eating a particular kind of dates, which brought on a complaint in his ſtomach, and reduced him to the moſt imminent danger. Senſible of his approaching diſſolution, he wrote letters into all the provinces, announcing his brother Motaſſem his ſucceſſor; and then patiently awaited the event. After a tedious ſtruggle under the preſſure of his diſeaſe, and while uttering this ejaculation; "O thou who never dieſt, have mercy on me, a dying man!" he expired at the age of forty-eight or forty-nine years. He reigned 20 years and ſome months, and was buried at Tarſus, which ſome religious zealots interpreted as a mark of reprobation.

The hiſtory of this caliph affords an illuſtrious inſtance of the meliorating effect of ſcience and literature upon the conduct and temper of rude and uncultivated men. Under the milder features of a liberal, virtuous, and beneficent ſovereign, the uſual cruelty of a Saracen and a deſpot ſeemed entirely loſt. He diſplayed an uncommon greatneſs of mind and an unuſual example of clemency in his conduct towards his rival and uncle Ibrahim. After his depoſition, that prince concealed himſelf in ſome ſequeſtered corner of Bagdad. The place of his concealment being at length diſcovered, he was inſtantly brought before the caliph, and informed that the counſel had unanimouſly condemned him to death. "Your counſellors (ſaid Ibrahim) have judged according to the cuſtomary rules of political government; if you pardon me, you will not, indeed, judge according to precedent, but you will have no equal among ſovereigns." The caliph roſe up and embracing him tenderly, with great emotion, ſaid, "Uncle be of good cheer; I will not do you the leaſt injury;" and he added to forgiveneſs a fortune ſuitable to his birth and former elevated ſtation. When Almamon's courtiers complimented him on this generous action, he exclaimed, "O! did men but know the pleaſure I feel in pardoning, all who have offended me would come and confeſs their faults." To the ſame generoſity of diſpoſition may be aſcribed his ſtrong predilection to the oppreſſed houſe of Ali, which filled the beginning of his reign with political troubles. By his frequent intercourſe with men of enlightened minds, and of different religious ſentiments, he acquired a liberality very unuſual in a Muſſulman; and his preference to ſome particular opinions ſeems to have originated from his own vigour of mind, and his knowledge of theſe opinions. (*Gen. Biog.*)

ALMANACK, a book or table, containing a kalendar of days and months, the riſing and ſetting of the ſun, the age of the moon, the eclipſes of both luminaries, &c.—Authors are divided with regard to the etymology of the word; ſome deriving it from the Arabic particle *al* and *manach*, to count; ſome from *almanach*, new-year's gifts, becauſe the Arabian aſtrologers uſed at the beginning of the year to make preſents of their ephemerides; and others, from the Teutonic *almaen achte*, obſervations on all the months. Dr Johnſon derives it from the Arabic particle *al*, and the Greek μην, a month. But the moſt ſimple etymology appears from the common ſpelling; the word being compoſed of two Arabic ones, *Al Manack*, which ſignify *the Diary*. All the claſſes of Arabs are commonly much given to the ſtudy of aſtronomy and aſtrology; to both which a paſtoral life, and a ſort of huſbandry, not only incline them, but afford time and opportunity to cultivate them. They neither ſow, reap, plant, travel, buy or ſell, or undertake any expedition or buſineſs, without previouſly conſulting the ſtars, or, in other words, their almanacks, or ſome of the makers of them. From theſe people, by their vicinity to Europe, this art, no leſs uſeful in one ſenſe than trifling and ridiculous in another, hath paſſed over hither: and thoſe aſtronomical compoſitions have ſtill everywhere not only retained their old Arabic name; but were, like theirs, for a long while, and ſtill are among many European nations, interſperſed with a great number of aſtrological rules for planting, ſowing, bleeding, purging, &c. down to the cutting of the hair and paring of the nails.—Regiomontanus appears to have been the firſt in Europe, however, who reduced almanacks into their preſent form and method, gave the characters of each

Almanack. each year and month, foretold the eclipſes and other phaſes, calculated the motions of the planets, &c. His firſt almanack was publiſhed in 1474.

The eſſential part of an almanack is the kalendar of months and days, with the riſings and ſettings of the ſun, age of the moon, &c. To theſe are added various parerga, aſtronomical, meteorological, chronological, political, rural, &c. as calculations and accounts of eclipſes, ſolar ingreſſes, prognoſtics of the weather, tables of the tides, terms, &c. liſts of poſts, offices, dignities, public inſtitutions, with many other articles political as well as local, and differing in different countries. A great variety are annually publiſhed in Britain; ſome for binding, which may be denominated *book almanacks;* others in looſe papers, called *ſheet almanacks.*

The modern almanack anſwers to the *Faſti* of the ancient Romans. See FASTI.

Conſtruction of ALMANACKS. The firſt thing to be done is, to compute the ſun's and moon's place for each day of the year, or it may be taken from ſome ephemerides and entered into the almanack; next, find the dominical letter, and, by means thereof, diſtribute the kalendar into weeks; then, having computed the time of Eaſter, by it fix the other moveable feaſts; adding the immoveable ones, with the names of the martyrs, the riſing and ſetting of each luminary, the length of day and night, the aſpects of the planets, the phaſes of the moon, and the ſun's entrance into the cardinal points of the ecliptic, i. e. the two equinoxes and ſolſtices. (See ASTRONOMY, *paſſim*). By the help of good aſtronomical tables or ephemerides, the conſtruction of almanacks is extremely eaſy.

For every almanack or kalendar for one year or leſs, a ſtamp duty of 8d. muſt be paid. And for every almanack ſerving more than a year, the ſame duty is paid for each year. Perpetual almanacks pay for three years only. All books and pamphlets ſerving chiefly the purpoſe of almanacks, are charged as ſuch. If any almanack contains more than one ſheet, one ſheet only need be ſtamped; and every almanack is required by law to be ſo printed, that ſome part of the print ſhall be upon the ſtamp. Selling unſtamped almanacks incurs the ſame penalty as for ſelling unſtamped newſpapers. Almanacks in bibles and common prayer books are exempted.

ALMANACK, among *Antiquaries*, is alſo the name given to a kind of inſtrument, uſually of wood, inſcribed with various figures and Runic characters, and repreſenting the order of the feaſts, dominical letters, days of the week, and golden number, with other matters neceſſary to be known throughout the year; uſed by the ancient northern nations, in their computations of time, both civil and eccleſiaſtical. Almanacks of this kind are known by various names, among the different nations wherein they have been uſed; as rimſtocks, primſtaries, runſtocks, runſtaffs, *Scipiones Runici*, *Bacculi Annales*, clogs, &c. They appear to have been uſed only by the Swedes, Danes, and Norwegians. From the ſecond of theſe people, their uſe was introduced into England, whence divers remains of them in the counties. Dr Plot has given the deſcription and figure of one of theſe clogs, found in Staffordſhire, under the title of *The Perpetual Staffordſhire Almanack.* The external figure and matter of theſe kalendars appear to have been various. Sometimes they were cut on one or more wooden leaves, bound together after the manner of books; ſometimes on the ſcabbards of ſwords, or even on daggers; ſometimes on tools and implements, as portable ſteelyards, hammers, the helves of hatchets, flails, &c. Sometimes they were made of braſs or horn: ſometimes of the ſkins of eels, which being drawn over a ſtick properly inſcribed, retained the impreſſions of it. But the moſt uſual form was that of walking ſtaves, or ſticks, which they carried about with them to church, market, &c. Each of theſe ſtaves is divided into three regions; whereof the firſt indicates the ſigns, the ſecond the days of the week and year, and the third the golden number. The characters engraven on them are, in ſome, the ancient Runic; in others the later Gothic characters of Ulfilus. The ſaints days are expreſſed in hieroglyphics, ſignificative either of ſome endowment of the ſaint, the manner of his martyrdom, or the like. Thus, againſt the notch for the firſt of March, or St David's day, is repreſented a harp; againſt the 25th of October, or Criſpin's day, a pair of ſhoes; againſt the 10th of Auguſt, or St Lawrence's day, a gridiron; and laſtly, againſt New-year's day, a horn, the ſymbol of liberal potations, which our anceſtors indulged in at that ſeaſon.

Almanſor. ALMANSOR the Victorious, the ſecond caliph of the houſe of Al Abbas, ſucceeded his brother Abul Abbas Al Saffah, in the year 753, of the Hegira 136, and in the following year was inaugurated at Al Haſhemiyah. Although Al Saffah had declared him preſumptive heir of the crown, and he had been proclaimed caliph in the imperial city of Anbar, yet immediately upon his inauguration, his uncle Abdallah ebn Ali had ſufficient intereſt to cauſe himſelf to be proclaimed caliph at Damaſcus. In Arabia, Syria, and Meſopotamia, he collected a numerous army, and arrived at the banks of the Maſius, near Niſibis, where he encamped, ready to diſpute his royal acceſſion by arms. Almanſor collected an immenſe army in Perſia, Khoraſan, and Irak, and gave the command of it to Abu Moſlem, who haraſſed his uncle's troops for five months, and at laſt totally defeated him, A. D. 754. Notwithſtanding the ſervices which Abu Moſlem had rendered to the family of Al Abbas, after this victory he became an object of jealouſy, and was aſſaſſinated in the preſence of Almanſor himſelf, by his expreſs order. After the death of Abu Moſlem, the ſtandard of rebellion was raiſed by Sinon a Magian, who ſeized on the treaſures of the deceaſed governor of Khoraſan, and excited the people of that country to a general revolt; but this inſurrection was ſuddenly quelled by the general of Almanſor, Jamhur ebn Morad. The caliph avariciouſly ſeized the ſpoils of this victory, which ſo incenſed Jamhur that he immediately turned his arms againſt his royal maſter; but he was ſoon defeated by the caliph's forces. The patriarch of Antioch was about this time detected in an illicit correſpondence with the Grecian emperor, and conſequently was baniſhed into an obſcure part of Paleſtine; and in the mean time the Chriſtians in the dominions of the caliph were prohibited from building or repairing any churches, and alſo were laid under ſeveral other ſevere reſtraints.

Almanſor ſent a large army into Cappadocia in the year 757, fortified the city of Malatia or Melitene,

litene, and depofited in it a great part of his treafures. But in this year he was attacked by a fect of believers in the metempfychofis, called the *Rawandians*. This fect affembled at Al Hafhemiyah the refidence of the caliph, and by the ceremony of going in proceffion round his palace, intimated their purpofe of invoking him as a deity, and paying him divine homage. Incenfed by their impiety, the caliph ordered feveral of thefe fectaries to be imprifoned, which roufed their refentment, and led them to form the defign of his affaffination. The generous interpofition of Maan ebn Zaidet an Ommiyan chief, who had been under the neceffity of concealing himfelf from the caliph's refentment, however defeated their intention. This infult received in his capital, induced him to build the city of Bagdad, and to fix his refidence there, A. D. 762. In the preceding year a plan was formed to dethrone him; but it being difcovered, he feverely punifhed all who were either directly or indirectly concerned in it. Abdallah his uncle fhared the fate of other rebels: for being allured to court under the promife of pardon and protection, he was placed in a building which was fo conftructed that it immediately fell and crufhed him in its ruins. Not long after his refidence at Bagdad, he was feized with a diforder of which he was cured by the advice of a famous Chriftian phyfician, whofe name was George ebn Baktifhua Al Jondifaburi. The caliph, previoufly informed that he was married to a wife old and infirm, as a recompenfe prefented him with three beautiful Greek girls, and a confiderable fum of money; the girls, to the caliph's furprife, were fent back, with a declaration on the part of George, that it was not lawful for a Chriftian to have more wives than one at a time. The conduct of the phyfician, on this occafion, raifed him in the efteem of the caliph, and procured him a greater profufion of favours. In his fucceeding military tranfactions, Almanfor was generally victorious. His conduct to his Chriftian fubjects was rigorous and fevere. He fet out on a pilgrimage to Mecca in the year 774, and being feized on the road with a dangerous difeafe, he fent for his fon and intended fucceffor Al Mohdi, and gave him fome falutary advice. "I command you" faid he, "to treat publicly your relations with the greateft marks of diftinction, fince this conduct will reflect no fmall degree of honour and glory upon yourfelf. Increafe the number of your freedmen, and treat them with all kindnefs, as they will be of great fervice to you in your adverfity; but neither this, nor the other injunction will you fulfil. Enlarge not that part of your capital erected on the eaftern bank of the Tigris, as you will never be able to finifh it; but this work I know you will attempt. Never permit any of your women to intermeddle in affairs of ftate, or to have any influence over your counfels; but this advice I know you will not take. Thefe are my laft commands; or, if you pleafe, my dying advice; and to God I now recommend you." In parting they both gave vent to their feelings in a flood of tears. He purfued his journey to Bir-Maimun, *i. e.* the well of Maimun, where he died in the 63d year of his age and the 20th of his reign, and his remains were interred at Mecca.

The character of Almanfor was formed of very different and even contradictory qualities. His temper conciliated affection and attachment in private life, but in his public character his afpect and demeanour infpired terror. He was well acquainted with the arts of government; he was prudent and brave, but perfidious, covetous, cruel, and implacable; and amid fuch a variety of character, it is fingular that he fhould have difplayed a love of ftudy and literature, and particularly of aftronomy. (*Gen. Biog.*)

ALMANZA, a little town of New Caftile, on the frontiers of the kingdom of Valencia in Spain, fituated in W. Long. 1. 19. N. Lat. 38. 54. It is remarkable for the defeat of the allies in 1707, under the marquis de las Minas and the earl of Galway. In the beginning of this action the Englifh troops penetrated through the centre of the Spanifh army; but the Portuguefe cavalry being broken by the Spanifh, and the French infantry making a dreadful fire on their flanks, the allied army was at laft broken, and began their retreat when it was almoft dark. Colonel Hill carried off the remains of thirteen battalions towards the river Xucar, which, if they could have paffed, they might have been fafe: but being very much fatigued, they were obliged to halt; by which means they were furrounded, and forced to furrender prifoners of war. In this battle, the allies loft 120 ftandards, together with all their artillery and baggage; a great number were killed, and feveral thoufands taken prifoners. The Marquis de las Minas was dangeroufly wounded; and his miftrefs, in the garb of an amazon, killed by his fide. The earl of Galway had two cuts acrofs the face, which, though not dangerous, had prevented him from feeing, or giving orders properly.

Heresy of ALMARIC, a tenet broached in France by one Almaric, in the year 1209. It confifted in affirming, that every Chriftian was actually a member of Chrift; and that without this faith no one could be faved. His followers went farther, and affirmed, that the power of the Father lafted only during the continuance of the Mofaic law; that the coming of Chrift introduced a new law; that at the end of this began the reign of the Holy Ghoft; and that now confeffion and the facraments were at an end, and that every one is to be faved by the internal operations of the Holy Spirit alone, without any external act of religion.—Their morals were as infamous as their doctrine was abfurd. Their tenets were condemned by a public decree of the council of Sens, in the year 1209.

ALME, or Alma, finging and dancing girls in Egypt, who, like the Italian *Improvifatori*, can occafionally pour forth "unpremeditated verfe." They are called *Almé*, from having received a better education than other women. They form a celebrated fociety in that country. To be received into it, according to M. Savary, it is neceffary to have a good voice, to underftand the language well, to know the rules of poetry, and be able to compofe and fing couplets on the fpot, adapted to the circumftances. The Almé know by heart all the new fongs. Their memory is furnifhed with the moft beautiful tales. There is no feftival without them; no entertainment of which they do not conftitute the ornament. They are placed in a roftrum, from whence they fing during the repaft. They then defcend into the faloon, and form dances which have no refemblance to ours. They are pantomime ballets, in which they reprefent the ufual occurrences of life. The myfteries of love, too, generally

nerally furnish them with scenes. The suppleness of their bodies is inconceivable. One is astonished at the mobility of their features, to which they give at pleasure the impression suited to the characters they play. The indecency of their attitudes is often carried to excess. Their looks, their gestures, every thing speaks, but in so expressive a manner, that it is impossible to mistake them. At the beginning of the dance, they lay aside with their veils the modesty of their sex. A long robe of very thin silk goes down to their heels, which is slightly fastened with a rich girdle. Long black hair, plaited and perfumed, is flowing on their shoulders. A shift, transparent as gauze, scarcely hides their bosom. As they put themselves in motion, the shapes, the contours of their bodies, seem to develope themselves successively. Their steps are regulated by the sound of the flute, of castanets, the tambour de basque, and cymbals, which accelerates or retards the measure. They are still further animated by words adapted to such scenes. They appear in a state of intoxication. They are the Bacchants in a delirium. It is when they are at this point, that throwing off all reserve, they abandon themselves totally to the disorder of their senses; it is then that a people far from delicate, and who like nothing hidden, redouble their applauses. These Almé are sent for into all the harams. They teach the women the new airs; they amuse them with amorous tales, and recite in their presence poems, which are so much the more interesting, as they furnish a lively picture of their manners. They initiate them into the mysteries of their art, and teach them to contrive lascivious dances. These girls, who have cultivated understanding, are very agreeable in conversation. They speak their language with purity. The habit of dedicating themselves to poetry renders the softest and most sonorous expressions familiar to them. They repeat with a great deal of grace. In singing, nature is their only guide. Sometimes two of them sing together, but always with the same voice. It is the same with an orchestra, where all the instruments playing in unison execute the same part.

The Almé assist at the marriage-ceremonies, and march before the bride, playing on instruments. They make a figure likewise at funerals, and accompany the procession, singing sorrowful airs. They break forth into groans and lamentations, and give every sign of grief and despair. These women are paid very high, and seldom appear but amongst the grandees and rich men.

The common people have also their Almé. They are girls of the second class, who try to imitate the former; but they have neither their elegance, their graces, nor their knowledge. They are everywhere to be met with. The public places and the walks about Grand Cairo are full of them. As the populace require allusions still more strongly marked, decency will not permit the relation to what a pitch they carry the licentiousness of their gestures and attitudes.

ALMEDIA, a frontier town of Portugal, in the province of Tralos Montes, on the confines of Leon, where there was a very brisk action between the French and Portuguese in 1663; 17 miles north-west of Cividad Rodrigo. W. Long. 7. 10. N. Lat. 40. 41.

ALMEHRAB, in the *Mahometan Customs*, a niche in their mosques, pointing towards the kebla or temple of Mecca, to which they are obliged to bow in praying. See KEBLA.

ALMEISAR, a celebrated game among the ancient Arabs, performed by a kind of casting of lots with arrows, strictly forbidden by the law of Mahomet, on account of the frequent quarrels occasioned by it.

The manner of the game was thus: A young camel being brought and killed, was divided into a number of parts. The adventurers, to the number of seven, being met, 11 arrows were provided without heads or feathers; seven of which were marked, the first with one notch, the second with two, the third with three, &c. the other four had no marks. These arrows were put promiscuously into a bag, and thus drawn by an indifferent person. Those to whom the marked arrows fell, won shares in proportion to their lot; the rest to whom the blanks fell, were entitled to no part of the camel, but obliged to pay the whole price of it. Even the winners tasted not of the flesh themselves more than the losers, but the whole was distributed to the poor.

ALMENE, in *Commerce*, a weight of two pounds used to weigh saffron in several parts of the continent of the East Indies.

ALMERIA, a sea-port town in the kingdom of Granada in Spain, pleasantly situated on a fine bay at the mouth of the river Almeria, on the Mediterranean. W. Long. 3. 20. N. Lat. 36. 51. This town is by some thought to have risen upon the ruins of the ancient Abdera, and was formerly a place of great consequence. It was taken from the Moors in 1147, by the emperor Conrad III. in conjunction with the French, Genoese, and Pisans. It was at that time the strongest place in Spain held by the Infidels; from which their privateers, which were exceedingly numerous, not only troubled the sea-coasts inhabited by the Christians, but gave equal disturbance to the maritime provinces of France, Italy, and the adjacent islands. The city being well fortified, having a strong castle, a numerous garrison, and being excellently provided with every thing necessary, made a vigorous resistance; but was at last taken by storm, when the victor put to the sword all the inhabitants who were found in arms, distributing the best part of the plunder among his allies, whom he sent away thoroughly satisfied. The Genoese, particularly, acquired here that emerald vessel which still remains in their treasury, and is deemed invaluable.

Upon its reduction by the Christians, Almeria became a bishopric; but is at present very little better than a village, indifferently inhabited, and has nothing to testify so much as the probability of its former greatness, except certain circumstances which cannot be effaced even by the indolence of the Spaniards themselves. What these are, Udal ap Rhys, a Welshman, thus describes, in his Tour through Spain and Portugal. "Its climate (says he) is so peculiarly blessed, that one really wants words to express its charms and excellence. Its fields and meads are covered with flowers all the year round; they are adorned also with palms, myrtles, plane trees, oranges, and olives; and the mountains and promontories near it are as noted for their producing a great variety of precious stones, insomuch that the next promontory to it is called the *Cape of Gates*, which is a corruption from the word *agates*, the

 hills

hills thereabouts abounding in that sort of precious stones, as well as in emeralds and amethysts, garnets or coarse rubies, and extreme curious alabaster in the mountains of Filaures."

ALMIGGIM. See Almuggim.

ALMEYDA, Don Francis, was the son of the Count d'Abrantes, a grandee of Portugal, who served with great distinction in the war of Ferdinand of Castile with Granada; and in consequence of his important services he became highly esteemed in the court of his sovereign. Without any solicitation on his part he was nominated the first governor general and viceroy of the newly conquered countries in the East Indies; and set sail from Lisbon in March 1505-6 with a powerful fleet. To give dignity and influence to his elevated station, a body of guards was appointed to attend his person, several chaplains were assigned him, together with every other appendage of grandeur. He touched at the Cape Verd islands, doubled the Cape at a considerable distance to the south, and arrived at Guiloa. From thence he proceeded to Mombaza, a well fortified city in an island, which he reduced, and proceeded to the Angediva islands not far from Goa, where he built a fort; he likewise erected and garrisoned another fort at Cannanor, and arriving at Cochin, he secured it to the Portuguese interest. The island of Madagascar was discovered during his government, and his son Don Lorenzo first surveyed the Maldive islands; and about the same time discovered the fine island of Ceylon, the principal sovereign of which he brought under submission to the crown of Portugal. Returning from this expedition, while employed in the fleet destined against Calicut, he lost his life in a sea-fight against the Zamorin. His father sustained his loss with a heroic firmness, saying, "that Lorenzo could not die better than in the service of his country." On the arrival of Alphonso d'Albuquerque, who was destined to be his successor, Almeyda yielded to the impressions of jealousy; and under the pretence of misconduct he confined him in the citadel of Cannanor. He engaged in 1508, the whole force of the Mahometans in the port of Diu; and, gaining a complete victory, facilitated the enterprises of Albuquerque his successor, by contributing to break that formidable league by which the Zamorin was in hopes of being able to compel the Portuguese to abandon their Indian conquests. Returning home with the great riches which he had acquired, he unfortunately touched at Saldanha Point on the coast of Africa, where some of the sailors, in quest of water, quarrelled with the natives, who attacked and drove them to their ships. With a view to revenge this pretended affront, they persuaded Almeyda himself to go ashore, with a body of 150 men, armed only with swords and lances. While stepping into the boat, Almeyda exclaimed, "whither do you carry my 60 years?" The Portuguese furiously rushed on to attack the natives, whose numbers were greatly augmented, and Almeyda with 57 of his men were killed in this rash and unprovoked attempt. (*Gen. Biog.*)

ALMISSA, a small but strong town at the mouth of the Cetina, in Dalmatia, famous for its piracies; ten miles east of Spalatro. E. Long. 18. 14. N. Lat. 43. 56..

ALMOHEDES, the name of a dynasty, which, in the commencement of the twelfth century, succeeded that of the Almoravides in Barbary. It derived its name from an obscure founder called Al Mohedi, or Al Mohedes, and it rose into public notice in the 25th year of the reign of Al Abraham, or Brahem, who succeeded his father Ali, A. D. 1115. This person was a Bereber, and was a famous preacher of the tribe of Muzamada, which was settled along Mount Atlas. His scheme was the exertion of ingenuity, and it was executed with unremitting activity. In order to obtain attention and success, he assumed the title of Mohdi or Mohedi, and claimed the honour of leader of the orthodox, or unitarians, and, by his preaching they became so numerous, that he even dared to set the royal power at defiance. Confident of security, and immersed in pleasure, Brahem looked with a contemptuous eye upon the insurrection of a party composed of such persons. They increased in number and strength, so that the king was at last roused from his indolence, and prepared for his own security and their subjection. In the first engagement he was defeated, being overpowered with superior numbers. The artful Abdallah took possession of the capital, so that Brahem, pursued as a fugitive by Abdolmumen, one of the party, sought refuge in the city of Fez. The gates were shut against him; but they were opened to admit his pursuers. He next took refuge in the city of Auran, or Oran; but he was pursued by Abdolmumen, who threatened to destroy the city with fire and sword; and the magistrates, unable to defend themselves, urged him to leave the town, and provide for his own safety. Concealed by the darkness of the night, he escaped with his favourite wife on horseback behind him; but being closely pursued by the enemy, rather than fall into their hands, he rushed over a precipice, and, along with his wife, he was dashed to pieces. Such was the death of this prince, which put a final period to the empire of the Almoravides. When the death of Brahem was known, Abdolmumen was chosen by the chiefs of that party his successor, and proclaimed king of the Almohedes, under the title of Al Emir Al Mumin Abdallah Mohammed Abdal Mumin Ebn Abdallah Ibni Ali, i. e. Chief or Emperor of the true Believers of the house of Mohammed Abdal Mumin, the son of Abdal Mumin, the son of Abdallah, of the lineage of Ali. Abdallah, during his reign, enacted prudential laws for the establishment of his new kingdom, and the regulation of the conduct of his followers. He appointed a council of forty of his disciples, all of whom were preachers. Some of these were commissioned to regulate all public affairs; and at proper seasons they went forth as itinerant preachers for the purpose of strengthening their party, and spreading their doctrines, and sixteen of their number acted as secretaries. As both the regal and pontifical dignities were united in the same person, the king was chosen from both of these two classes. The disciples of this sect were denominated Mohameddin, or Ali Mohaddin; but the Arabian writers only style them preachers, and the Spanish Al Mohedes. The descendants and successors of that tribe continued to retain the appellation of Emir Al Mumenin, or chiefs of the faithful believers, as long as their dynasty lasted; and they became very powerful both in Africa and Spain. By their invectives against the

the tyranny of the Almoravides, and their loud clamours for liberty, they induced the greater part of the kingdom to revolt, and to embrace their religious doctrines. The chief thing in them was their ſpecious pretence to orthodoxy, and ſtrict adherence to the unity of the Godhead, which they inculcated with the greateſt zeal and diligence.

On his acceſſion to power, the new ſovereign extirpated all the unhappy remains and ſteady adherents of this race, by ſtrangling Iſaac the ſon of Brahem. The Almoravides governor taking advantage of the general tumult and diſtraction that prevailed, conſtituted their governments into independent principalities and petty kingdoms; and they who inhabited the mountainous parts, eſtabliſhed under their own cheyks a variety of lordſhips. The Libyans and Nubians took the lead, and the ſtates of Barbary, Tripoli, Kairwan, Tunis, Algiers, Tremecen, and Bujeyah, followed their example. Abdolmumen, however, ſucceſsfully purſued his conqueſts; and in a few years he reduced to his ſubjection the Numidians and Galatians in the weſt, and the kingdoms of Tunis, Tremecen, and the greateſt part of Mauritania and Tingitana. He expelled the Chriſtians of Mohedia, the chief city of Africa, and ſome others on the ſame coaſt; and likewiſe made conqueſts both in Spain and Portugal. He died in the ſeventh year of his reign, and was ſucceeded, A. D. 1156, by his ſon Yuſef or Joſeph. Yuſef proved a valiant and martial prince, and in his military court he firſt eſtabliſhed the kings of Tunis and Bujeyah in their reſpective dominions, as his tributaries and vaſſals; and then by earneſt ſolicitation he embarked for Spain to aſſiſt the Mooriſh princes. Yakub or Jacob, or the conqueror, ſucceeding him after providing for his own ſafety againſt the revolted and plundering Arabs, purſued his conqueſts with ſuch ſucceſs, that he ſoon became maſter of the whole country lying between Numidia and the entire length of the Barbary coaſts, from Tripoli to the boundaries of the kingdom of Morocco. Thus he was acknowledged as ſovereign by moſt of the Arabian Mooriſh princes in his Spaniſh dominions; but alſo extended his territory above 1200 leagues in length, and 480 in breadth. The remaining part of the hiſtory of this prince is involved in obſcurity. About the year 1206, he quelled a revolt in Morocco, but violated his faith with the governor of the capital, which he reduced, and in a cruel and perfidious manner he extirpated all his adherents. Touched, it is ſaid, with remorſe, he diſappeared, and, according to report, wandered about obſcure and unknown, until he died in the humble condition of a baker at Alexandria. His ſon Mohammed, ſurnamed Al Naker, ſucceeded his father; and, on his acceſſion to the crown, he paſſed over into Spain with an immenſe army of 120,000 horſe and 300,000 foot, and engaging the whole force of the Chriſtians on the plains of Tholoſa, received a total defeat, with the loſs of above 150,000 foot, 30,000 horſe, and 50,000 priſoners. According to Spaniſh and other hiſtorians, this famous battle was fought in 617, A. D. 1220; but according to the Arabian writers, it was in the year of the Hegira 609, A. D. 1212. Returning home to Africa, he was received with coldneſs and diſguſt by his ſubjects, on account of his defeat; and ſoon after died of vexation, having appointed his grandſon Zeyed Arrax his ſucceſſor. A deſcendant of the Abdolwates, ancient monarchs of the kingdom, named Gamarazan Ebn Zeyen, of the tribe of the Zeneti, cauſed him to be aſſaſſinated. With him terminated the dynaſty or government of the Almohedes, having poſſeſſed it for about 170 years, which gave place to that of the Benimerini, another branch of the Zeneti. Theſe having enlarged their conqueſts, and enriched themſelves by frequent inroads, not only into the neighbouring kingdoms, but even Nubia, Libya, and Numidia, were at length loſt in the general prevalence of Mohamediſm, after having exiſted 117 years. (*Mod. Univ. Hiſt.*)

ALMOND, the fruit of the almond tree. See AMYGDALUS, BOTANY *Index*.

ALMOND, in *Commerce*, a meaſure by which the Portugueſe ſell their oil: 26 almonds make a pipe.

ALMONDS, in *Anatomy*, a name ſometimes given to two glands, generally called the *tonſils*.

ALMONDS, among *Lapidaries*, ſignify pieces of rock-cryſtal, uſed in adorning branch-candleſticks, &c. on account of the reſemblance they bear to the fruit of that name.

ALMOND Furnace, among *Refiners*, that in which the ſlags of litharge, left in refining ſilver, are reduced to lead again by the help of charcoal.

ALMONDBURY, a village in England, in the weſt riding of Yorkſhire, ſix miles from Halifax.

ALMONER, in its primitive ſenſe, denotes an officer in religious houſes, to whom belonged the management and diſtribution of the alms of the houſe. By the ancient canons, all monaſteries were to ſpend at leaſt a tenth part of their income in alms to the poor. The almoner of St Paul's is to diſpoſe of the moneys left for charity, according to the appointment of the donors, to bury the poor who die in the neighbourhood, and to breed up eight boys to ſinging, for the uſe of the choir. By an ancient canon, all biſhops are required to keep almoners.

Lord ALMONER, or *Lord High ALMONER of England*, is an eccleſiaſtical officer, generally a biſhop, who has the forfeiture of all deodands, and the goods of *felos de ſe*, which he is to diſtribute among the poor. He has alſo, by virtue of an ancient cuſtom, the power of giving the firſt diſh from the king's table to whatever poor perſon he pleaſes, or, inſtead of it, an alms in money.

Great ALMONER, *Grand AUMONIER*, in France, before the revolution, was the higheſt eccleſiaſtical dignity in that kingdom. To him belonged the ſuperintendency of all hoſpitals and houſes of lepers. The king received the ſacrament from his hand; and he ſaid maſs before the king in all grand ceremonies and ſolemnities.

ALMONER is alſo a more faſhionable title given by ſome writers to chaplains. In this ſenſe we meet with almoner of a ſhip, almoner of a regiment.

ALMONRY, or AUMBRY, the office or lodgings of the almoner; alſo the place where alms are given. See AMBRY.

ALMORAVIDES, in *Hiſtory*, the name of an Arab tribe, who took poſſeſſion of a diſtrict of Africa, with the pretence of living in retirement, that their minds might not be diſtracted from the rigid obſervance of the precepts of the Koran. Hence they aſſumed the name of Morabites, which was changed by the

the Spaniards into that of Almoravides. Abubeker ben Omar, called by the Spanish authors Abu Texefien, was the first chief of this tribe. Supported by a powerful army of malecontents from the provinces of Numidia and Libya, which was assembled by the influence of the Morabites, or Marabouts, he founded the dynasty of the Almoravides in Barbary, in the year 1051. Texefien was succeeded by his son Yusef or Joseph, who, after having reduced to a state of vassalage the kingdoms of Tremecen, Fez, and Tunis, passed over into Spain during the time of the civil wars, vigorously repulsed the Christians, and soon saw the greatest part of the kingdoms of Murcia, Granada, Cordova, Leon, and some parts of Valencia, subjected to his power. He then returned into Africa, and left his newly acquired dominions, with a considerable army, under the government of his nephew Mohammed. On his arrival in Africa, with a view to prosecute and extend his conquests in Spain, he announced, in a public declaration, a general *gazie*, or religious war; assembled a numerous army, with which he embarked at Ceuta; and rejoining his nephew in Andalusia, soon laid waste that province with fire and sword.

In the year 1107, five years afterwards, he undertook another invasion, penetrated into the kingdom of Portugal, and reduced the city of Lisbon, with a considerable part of the kingdom. At this time he lost the cities of Alguazir and Gibraltar, which he had formerly taken. On his return to Barbary, he was defeated at sea. This induced him to propose a truce, which was agreed to only on condition of his submitting to become the tributary of the Spanish king. Indignant at these humiliating terms, Yusef made a vow that he would never desist in his attempts, till he had utterly rooted out the Christian religion in Spain. He made preparations accordingly for a fresh invasion, embarked his army, and landing at Malaga, marched into the enemy's country. His progress was rapid; but his measures were inconsiderately planned and rashly executed. In the famous battle of the Seven Counts, he was indeed victorious, but after a terrible slaughter, and the loss of great part of his army. This disastrous victory obliged him to return to Africa; and he died soon after at his capital of Morocco. Ali his son, succeeded to the sovereignty in 1110. This prince who seems to have been of a less warlike disposition than his father, neglecting his Spanish conquests, turned his attention to the arts of peace, and erected many sumptuous buildings, and in particular the great mosque of Morocco. Alphonso, then king of Arragon, retook from him some considerable cities; which obliged him to undertake an expedition to Spain in support of the Moorish princes. But all his attempts proved unfortunate; and in his last enterprise, though powerfully assisted by the Moorish chiefs, with the loss of 30,000 men he was defeated and slain by Alphonso, in the sixth year of his reign.

He was succeeded by his son Al Abraham, who devoted himself entirely to pleasure. His subjects were harassed and oppressed with heavy taxes, which excited discontent and open rebellion. A revolution was soon effected, and in the 25th year of his reign, the government transferred from the tribe of the Almoravides to the Almohedes. (*Mod. Univ. Hist.*)

ALMS, a general term for what is given out of charity to the poor.

In the early ages of Christianity, the alms of the charitable were divided into four parts; one of which was allotted to the bishop, another to the priests, and a third to the deacons and subdeacons, which made their whole subsistence; the fourth part was employed in relieving the poor, and in repairing the churches.

No religious system is more frequent or warm in its exhortations to almsgiving than the Mahometan. The Alcoran represents alms as a necessary means to make prayer be heard. Hence that saying of one of their caliphs: "Prayer carries us half way to God, fasting brings us to the door of his palace, and alms introduces us into the presence chamber." Hence many illustrious examples of this virtue among the Mahometans. Hasan, the son of Ali, and grandson of Mohammed, in particular, is related to have thrice in his life divided his substance equally between himself and the poor, and twice to have given away all he had. And the generality are so addicted to the doing of good, that they extend their charity even to brutes.

Alms, also denotes lands or other effects left to churches or religious houses, on condition of praying for the soul of the donor. Hence,

Free Alms, that which is liable to no rent or service.

Reasonable Alms, a certain portion of the estates of intestate persons, allotted to the poor.

Alms-Box, or *Chest*, a small chest, or coffer, called by the Greeks Κιβώτιον, wherein anciently the alms were collected, both at church and at private houses.

The alms-chest, in English churches, is a strong box, with a hole in the upper part, having three keys, one to be kept by the parson or curate, the other two by the church-wardens. The erecting of such alms-chest in every church is enjoined by the book of canons, as also the manner of distributing what is thus collected among the poor of the parish.

Alms-House, a petty kind of hospital, for the maintenance of a certain number of poor, aged, or disabled people.

ALMUCANTARS, in *Astronomy*, an Arabic word denoting circles of the sphere passing through the centre of the sun, or a star, parallel to the horizon, being the same as *Parallels of Altitude*.

Almucantar's-Staff, is an instrument usually made of pear-tree or box, having an arch of 15 degrees; used to take observations of the sun, about the time of its rising and setting, in order to find the amplitude, and consequently the variation of the compass.

ALMUCIUM denotes a kind of cover for the head, worn chiefly by monks and ecclesiastics. It was of a square form, and seems to have given rise to the bonnets of the same shape still retained in universities and cathedrals.

ALMUGGIM, Almiggim, or Almug tree, a certain kind of wood mentioned in the first book of Kings (x. 11.), which the Vulgate translates *ligna thyina*, and the Septuagint *wrought wood*. The Rabbins generally render it *coral;* others, *ebony*, *brazil*, or *pine*. But it is observed, that the almug tree can by no means be coral, because that is not fit for the purposes that the Scripture tells us the almug tree

was

was used, such as musical instruments, staircases, &c. The word *thyinum* is a name for the citron tree, known to the ancients, and very much esteemed for its sweet odour and great beauty. It came from Mauritania. The almug tree, or almugim, algumim, or simply gummim, taking *al* for a kind of article, is therefore by the best commentators understood to be an oily and gummy sort of wood; and particularly that sort of tree which produces the gum ammoniac, which is also thought to be the same with the Shittim wood, whereof there is such frequent mention made by Moses.

ALMUNECAR, a sea-port town in the kingdom of Granada, seated on the Mediterranean, with a good harbour, defended by a strong castle, 20 miles south of Alhama. W. Long. 3. 45. N. Lat. 36. 50.

ALNAGE, or AULNAGE, the measuring of woollen manufactures with an ell. It was at first intended as a proof of the goodness of that commodity; and accordingly a seal was invented as a mark that the commodity was made according to the statute; but, it being now possible to purchase these seals, they are affixed, whenever the vender pleases, to all cloths indiscriminately, to the great prejudice of our woollen manufactures.

ALNAGER, ALNEGER, or AULNEGER, q. d. *measurer by the ell*, signifies a sworn public officer, who, by himself or deputy, is to look to the assize of woollen cloth made throughout the land, i. e. the length, width, and work thereof; and to the seals for that purpose ordained. The office of king's aulnager seems to have been derived from the statute of Richard I. A. D. 1197, which ordained, that there should be only one weight and one measure throughout the kingdom; and that the custody of the assize, or standard of weights and measures, should be committed to certain persons in every city and borough. His business was, for a certain fee, to measure all cloths made for sale, till the office was abolished by the statute 11 and 12 W. III. cap. 20.

ALNUS, the ALDER TREE. See BETULA, BOTANY *Index*.

ALNUS, in the *Ancient Theatres*, that part which was most distant from the stage.

ALNWICK, a thoroughfare town in Northumberland, on the road to Scotland. Here Malcolm, king of Scotland, making an inroad into Northumberland, was killed, with Edward his son, and his army defeated by Robert Moubray, earl of this county, *anno* 1092. Likewise William, king of Scotland, in 1174, invading England with an army of 80,000 men, was here encountered, his army routed, and himself made prisoner. The town is populous, and in general well built; it has a large town-house, where the quarter-sessions and county-courts are held, and members of parliament elected. It has a spacious square, in which a market is held every Saturday. Alnwick appears to have been formerly fortified, by the vestiges of a wall still visible in many parts, and three gates which remain almost entire. It is governed by four chamberlains, who are chosen once in two years out of a common council, consisting of 24 members. It is ornamented by a stately old Gothic castle, which has been the seat of the noble family of Piercy, earls of Northumberland. As the audits for receipt of rents have ever been in this castle, it has always been kept in tolerable repair; and not many years ago, it was repaired and beautified by the duke of Northumberland, who made very considerable alterations, upon a most elegant plan, with a view to reside in it some part of the summer season. The manner of making freemen is peculiar to this place, and indeed is as ridiculous as singular. The persons who are to be made free, or, as the phrase is, leap the well, assemble in the market-place, very early in the morning, on the 25th of April, being St Mark's day. They appear on horseback, with every man his sword by his side, dressed in white, and with white nightcaps, attended by the four chamberlains and the castle bailiff, mounted and armed in the same manner; from hence they proceed, with music playing before them, to a large dirty pool, called *Freeman's-well*, where they dismount, and draw up in a body, at some distance from the water; and then rush into it all at once, and scramble through the mud as fast as they can. As the water is generally very foul, they come out in a dirty condition; but taking a dram, they put on dry clothes, remount their horses, and ride full gallop round the confines of the district; then re-enter the town, sword in hand, and are met by women dressed in ribbons with bells and garlands, dancing and singing. These are called *timber-wasts*. The houses of the new freemen are on this day distinguished by a great holly bush, as a signal for their friends to assemble and make merry with them after their return. This ceremony is owing to King John, who was mired in this well, and who, as a punishment for not mending the road, made this a part of their charter. Alnwick is 310 miles north by west from London, 33 north of Newcastle, and 29 south of Berwick. Long. 1. 10. Lat. 55. 24.

ALOA, in *Grecian Antiquity*, a festival kept in honour of Ceres by the husbandmen, and supposed to resemble our harvest-home.

ALOE, in *Botany*. See BOTANY *Index*.

American ALOE. See AGAVE, BOTANY *Index*.

ALOGIANS, in *Church History*, a sect of ancient heretics, who denied that Jesus Christ was the Logos, and consequently rejected the gospel of St John. The word is compounded of the privative α and λογος, q. d. *Without Logos* or *Word*. Some ascribe the origin of the name, as well as of the sect of Alogians, to Theodore of Byzantium, by trade a currier; who having apostatized under the persecution of the emperor Severus, to defend himself against those who reproached him therewith, said, that it was not God he denied, but only man. Whence his followers were called in Greek αλογοι, because they rejected the Word. But others, with more probability, suppose the name to have been first given them by Epiphanius in the way of reproach. They made their appearance toward the close of the second century.

ALOGOTROPHIA, among *Physicians*, a term signifying the unequal growth or nourishment of any part of the body, as in the rickets.

ALOOF, has frequently been mentioned as a sea-term: but whether justly or not, we shall not presume to determine. It is known in common discourse to imply *at a distance*; and the resemblance of the phrases *keep aloof*, and *keep a luff*, or *keep the luff*, in all probability gave rise to this conjecture. If it was really a sea-

sea-phrase originally, it seems to have referred to the dangers of a lee-shore, in which situation the pilot might naturally apply it in the sense commonly understood, viz. keep *all off*, or quite off: it is, however, never expressed in that manner by seamen now. See LUFF. It may not be improper to observe, that besides using this phrase in the same sense with us, the French also call the weather-side of a ship, and the weather-clue of a course, *le lof*.

ALOPECE, ALOPECIA, in *Ancient Geography*, an island placed by Ptolemy at the mouth of the Tanais, and called the island *Tanais*: now *l'Isle des Renards* (Baudrand). Also an island of the Bosphorus Cimmerius (Pliny); and another in the Ægean sea, over against Smyrna.

ALOPECIA, a term used among physicians to denote a total falling off of the hair from certain parts, occasioned either by the defect of nutritious juice, or by its vicious quality corroding the roots of it, and leaving the skin rough and colourless.

The word is formed from αλωπηξ, *vulpes*, "a fox;" whose urine, it is said, will occasion baldness, or because it is a disease which is common to that creature. It is directed to wash the head every night at going to bed with a ley prepared by boiling the ashes of vine branches in red wine. A powder made by reducing hermodactyls to fine flour is also recommended for the same purpose.

In cases where the baldness is total, a quantity of the finest burdock roots are to be bruised in a marble mortar, and then boiled in white wine until there remains only as much as will cover them. This liquor, carefully strained off, is said to cure baldness, by washing the head every night with some of it warm. A ley made by boiling ashes of vine branches in common water is also recommended with this intention. A fresh cut onion, rubbed on the part until it be red and itch, is likewise said to cure baldness.

A multitude of such remedies are everywhere to be found in the works of Valescus de Taranta, Rondeletius, Hollerius, Trincavellius, Celsus, Senertay, and other practical physicians.

ALOPECURUS, or FOXTAIL-GRASS. See BOTANY *Index*.

ALOPEX, in *Zoology*, a species of the canis, with a straight tail and black tip. It is commonly called the *field fox*.

ALOSA, the shad, or mother of herrings, a species of the clupea. See CLUPEA, ICHTHYOLOGY *Index*.

ALOST, a town in Flanders, belonging to the house of Austria, seated on the river Dender, in the midway between Brussels and Ghent. It has but one parish; but the church is collegiate, and has a provost, a dean, and 12 canons. Here is a convent of Carmelites, another of Capuchines, another of barefooted Carmelites, three nunneries, an hospital, and a convent of Guillemins, in which is the tomb of Theodore Martin, who brought the art of printing out of Germany into the Low Countries. He was the friend of Erasmus, and wrote his epitaph. Alost was taken and dismantled by Marshal Turenne in 1667; and after the battle of Ramillies in 1706, was abandoned to the allies. E. Long. 3. 56. N. Lat. 49. 55.

ALP ARSLAN, the second sultan of the dynasty of Seljuk in Persia, was the son of David, and great grandson of Seljuk the founder of the dynasty. He was born in the year 1030, of the Hegira 421. In place of Israel, which was his original name, he assumed that of Mohammed, when he embraced the Mussulman faith, and he obtained the surname, *Alp Arslan*, which in the Turkish language signifies *a valiant lion*, on account of his military prowess. Having held the chief command in Khorasan for ten years as lieutenant of his uncle Togrul Beg, he succeeded him in the year 1063, and at the commencement of his reign saw himself sole monarch of Persia, from the river Amu to the Tigris. When he assumed the reins of government, faction and open rebellion prevailed in his dominions, in subduing of which he was ably assisted by Nadham al Molk his visir, one of the most distinguished characters of his time, whose prudence and integrity in the administration of the affairs of the kingdom proved of most essential service to this prince and to his successor. Peace and security being established in his dominions, he convoked an assembly of the states; and having declared his son Malek Shaw his heir and successor, seated him on a throne of gold, and exacted an oath of fidelity to him from the principal officers of the empire. With the hope of acquiring immense booty in the rich temple of St Basil in Cæsarea, the capital of Cappadocia, he placed himself at the head of the Turkish cavalry, crossed the Euphrates, and entered and plundered that city. He then marched into Armenia and Georgia, which in the year 1065 he finally conquered. In the former country, the very name of a kingdom and the spirit of a nation were totally extinguished. But the native Georgians who had retired to the woods and vallies of Mount Caucasus made a more vigorous resistance. They too, however, overpowered by the arms of the sultan and his son Malek, were forced to submission, and reduced to slavery. To punish them for the brave defence which they had made, and as a badge of their humiliating condition, Alp Arslan obliged them to wear at their ears horse shoes of iron. Some, to escape this mark of cruelty and ignominy, professed to embrace the religion of Mahomet.

In the year 1068 Alp Arslan invaded the Roman empire, the seat of which was then at Constantinople. Eudocia, the reigning empress, saw and dreaded the progress of his arms. To avert the threatened danger, she married Romanus Diogenes, a brave soldier, who was accordingly associated with her in the government, and raised to the imperial dignity. The new emperor, during the exhausted state of their resources, sustained the Roman power with surprising valour and invincible courage. His spirit and success animated his soldiers in the field to act with fortitude and firmness, inspired his subjects with hope, and struck terror in his enemies. In three severe campaigns his arms were victorious; and the Turks were forced to retreat beyond the Euphrates. In the fourth he advanced with an army of 100,000 men into the Armenian territory for the relief of that country. Here he was met by Alp Arslan with 40,000 cavalry, or, according to some authors, a much smaller number; and the sultan having proposed terms of peace which were insultingly rejected by the emperor, a bloody and decisive engagement took place. Alp Arslan, it is said, when he saw that a battle was inevitable, wept at the thought that so many of his faithful followers must fall in in the ſtruggle; and after offering up a devout prayer, granted free permiſſion to all who choſe it to retire from the field. Then with his own hand he tied up his horſe's tail, exchanged his bow and arrows for a mace and ſcymitar, and robing himſelf in a white garment perfumed with muſk, reſolved to periſh on the ſpot unleſs he came off victorious. The ſkilful movements of the Turkiſh cavalry ſoon made an impreſſion on the ſuperior numbers of the Greeks, who were thrown into great diſorder, and after a terrible ſlaughter, were totally routed. Romanus, deſerted by the main body of his army, with unſhaken courage kept his ſtation, till he was recognized by a ſlave, taken priſoner, and conducted into the preſence of Alp Arſlan. In the Turkiſh divan, the captive emperor was commanded to kiſs the ground as a degrading mark of ſubmiſſion to the power and authority of the ſultan, who, it is ſaid, leapt from his throne and ſet his foot on his neck. But this is ſcarcely probable or conſiſtent with the generous and reſpectful treatment which he otherwiſe experienced. For the ſultan inſtantly raiſed him from the ground, embraced him tenderly, and aſſured him that his life and dignity ſhould remain inviolate under the protection of a prince who had not forgotten the reſpect due to the majeſty of his equals, and the viciſſitudes of fortune. When the terms of his ranſom were about to be ſettled, Romanus was aſked by Alp Arſlan what treatment he expected to receive. To this queſtion the emperor, with ſeeming indifference, replied, "If you are cruel, you will take my life; if you follow the dictates of pride, you will drag me at your chariot wheels; if you conſult your intereſt, you will accept a ranſom, and reſtore me to my country." "But what," ſays the ſultan, "would you have done in ſuch circumſtances?" "Had I been victorious," ſaid the inſolent Romanus, "I would have inflicted on thy body many a ſtripe." The conqueror ſmiled at the fierce and unſubdued ſpirit of his captive; obſerved that the Chriſtian precepts ſtrongly inculcated the love of enemies and the forgiveneſs of injuries; and, with a noble greatneſs of mind, declared that he would never imitate an example which he diſapproved. A ranſom of a million, an annual tribute of 3000 pieces of gold, an intermarriage between the families, and the deliverance of all the captive Muſſulmans in the power of the Greeks, were at laſt agreed to as the terms of peace and the liberty of the emperor. Romanus was now diſmiſſed loaded with preſents, and reſpectfully attended by a military guard. But the diſtracted ſtate of his dominions, the conſequence of a revolt of his ſubjects, precluded him from fulfilling the terms of the treaty, and remitting the ſtipulated price of his ranſom. The ſultan ſeemed diſpoſed to favour and ſupport the declining fortunes of his ally; but the defeat, impriſonment, and death of Romanus interrupted the accompliſhment of his generous, or rather ambitious, deſign.

At this time the dominion of Alp Arſlan extended over the faireſt part of Aſia; 1200 princes, or ſons of princes, ſurrounded his throne; and 200,000 ſoldiers were ready to execute his commands. He now meditated a greater enterpriſe, and declared his purpoſe of attempting the conqueſt of Turkeſtan, the original ſeat of his anceſtors. After great preparations for the expedition, he marched with a powerful army, and arrived at the banks of the Oxus. Before he could paſs the river with ſafety, it was neceſſary to gain poſſeſſion of ſome fortreſſes in its vicinity; one of which was for ſeveral days vigorouſly defended by the governor, Joſeph Cothual, a Carizmian. He was, however, obliged to ſurrender, and was carried a priſoner before the ſultan, who, being enraged at his obſtinacy and preſumption, addreſſed him in very reproachful terms. Joſeph replied with ſo much ſpirit, that he rouſed the reſentment of Alp Arſlan, and was commanded inſtantly to be faſtened by the hands and feet to four ſtakes, to ſuffer a painful and cruel death. Joſeph, on hearing this ſentence, became furious and deſperate; and drawing a dagger which he had concealed in his boots, ruſhed towards the throne to ſtab the ſultan: the guards raiſed their battle-axes, and moved forward to defend their ſovereign; but Alp Arſlan, the moſt expert archer of his age, checking their zeal, forbade them to advance, and drew his bow: his foot ſlipped, and the arrow miſſed Joſeph, who ruſhed forward, and plunging his dagger in the breaſt of the ſultan, was himſelf inſtantly cut in pieces. The wound proved mortal, and the ſultan expired in a few hours after he received it, in the year 1072. When he found his end approaching, he addreſſed himſelf in theſe words to his attendants: "In my youth," ſaid he, "I was adviſed by a wiſe man to humble myſelf before God, never to confide in my own ſtrength, or to deſpiſe the moſt contemptible enemy. Theſe leſſons I have neglected, for which I have now met deſerved puniſhment. Yeſterday, when I beheld from an eminence the number and diſcipline of my troops, I ſaid in the confidence of my heart, 'What power on earth can oppoſe me? what man dares to attack me?' To day, vainly truſting to my own ſtrength and dexterity, I fooliſhly checked the prompt zeal and alacrity of my guards for my ſafety, and now I have fallen by the hand of an aſſaſſin! But I perceive that no force or addreſs can reſiſt fate." He died in the 10th year of his reign, at the age of 44. He was buried at Maru, one of the four cities of Khoraſan, in the tomb of the Seljukian dynaſty. On his tomb was inſcribed the following epitaph: "All you who have beheld the grandeur of Alp Arſlan exalted to the heavens, come to Maru, and you will ſee it buried in the duſt."

This prince was diſtinguiſhed for his valour, liberality, and piety. He was patient, juſt, and ſincere. His ſtature, aſpect, and voice, commanded the reſpect of all who approached him. He had long whiſkers, and uſually wore a high turban in the form of a crown. He was ſucceeded by his ſon Malek Shaw, who had been proclaimed and acknowledged ſultan of the Turks during his life. (*Mod. Univ. Hiſt. Gibbon's Hiſt.*)

ALPHA, the name of the firſt letter of the Greek alphabet, anſwering to our A. As a numeral, it ſtands for one, or the firſt of any thing. It is particularly uſed, among ancient writers, to denote the chief or firſt man of his claſs or rank. In this ſenſe, the word ſtands contradiſtinguiſhed from *beta*, which denotes the ſecond perſon. Plato was called the *Alpha* of the wits: Eratoſthenes, keeper of the Alexandrian library, whom ſome called a *Second Plato*, is frequently named *Beta*.

ALPHA is alſo uſed to denote the beginning of any thing. In which ſenſe it ſtands oppoſed to *omega*, which

which denotes the end. And these two letters were made the symbol of Christianity; and accordingly were engraven on the tombs of the ancient Christians, to distinguish them from those of idolaters. Moralez, a Spanish writer, imagined that this custom only commenced since the rise of Arianism; and that it was peculiar to the orthodox, who hereby made confession of the eternity of Christ: but there are tombs prior to the age of Constantine whereon the two letters were found, besides that the emperor just mentioned bore them on his labarum before Arius appeared.

ALPHABET, the natural or customary series of the several letters of a language (see LANGUAGE and WRITING). The word is formed from *alpha* and *beta*, the first and second letters of the Greek alphabet. The number of letters is different in the alphabets of different languages. The English alphabet contains 24 letters; to which if we add *j* and *v* consonant, the sum will be 26: the French contains 23; the Hebrew, Chaldee, Syriac, and Samaritan 22 each; the Arabic 28; the Persian 31; the Turkish 33; the Georgian 36; the Coptic 32; the Muscovite 43; the Greek 24; the Latin 22; the Sclavonic 27; the Dutch 26; the Spanish 27; the Italian 20; the Ethiopic and Tartarian, each 202; the Indians of Bengal 21; the Baramese 19. The Chinese have, properly speaking, no alphabet, except we call their whole language by that name; their letters are words, or rather hieroglyphics, amounting to about 80,000.

It has been a matter of considerable dispute whether the method of expressing our ideas by visible symbols called *letters* be really a human invention; or whether we ought to attribute an art so exceedingly useful to an immediate revelation from the Deity.—In favour of the latter opinion it has been urged,

Arguments for writing being a divine revelation.

1. The five books of Moses are universally acknowledged to be the most ancient compositions as well as the most early specimens of alphabetical writing we have. If, therefore, we suppose writing to be the result of human ingenuity, it must be different from all other arts, having been brought to perfection at once; as it seems impossible to make any real improvement on the Hebrew alphabet. It may indeed be replied, that alphabetical characters perhaps have existed many ages before the writings of Moses, though the more ancient specimens have perished. This, however, being a mere unsupported assertion, without any historical testimony to corroborate it, cannot be admitted as a proof. Again, Setting aside the evidence to be derived from Scripture on this subject, the simplicity of manners predominant in the early ages, the small extent of the intellectual powers of mankind, and the little intercourse which nations had with one another, which would seem more particularly to render writing necessary, can scarcely allow us to suppose that such a complex and curious contrivance as alphabetical writing could be invented by a race of men whose wants were so few, their advantages so circumscribed, and their ideas so limited.

2. If alphabetical writing were a mere human invention, it might be expected that different nations would have fallen upon the same expedient independent of each other during the compass of so many ages. But no such thing has taken place; and the writing of every people on earth may be referred to one common original. If this can be proved, the argument from successive derivation, without a single instance of independent discovery, must be allowed to amount to the very highest degree of probability in favour of our hypothesis, which will now rest on the evidence for or against this fact; and which may be summed up in the following manner.

Among the European nations we find none who can pretend any right to the discovery of letters. All of them derived the art from the Romans, excepting only the Turks, who had it from the Arabians. The Romans never laid claim to the discovery; but confessed that they derived their knowledge from the Greeks, and the latter owned that they had it from the Phœnicians; who, as well as their colonists the Carthaginians, spoke a dialect of the Hebrew scarcely varying from the original. The Coptic, or Egyptian, resembles the Greek in most of its characters, and is therefore to be referred to the same original. The Chaldee, Syriac, and latter Samaritan, are dialects of the Hebrew, without any considerable deviation, or many additional words. The Ethiopic differs more from the Hebrew, but less than the Arabic; yet these languages have all issued from the same stock, as the similarity of their formation, and the numberless words common to them, all sufficiently evince; and the Persic is very nearly allied to the Arabic. Alterations indeed would naturally be produced, in proportion to the civilization of the several nations, and their intercourse with others; which will account for the superior copiousness of some above the rest. It appears then, that all the languages in use amongst men that have been conveyed in alphabetical characters, have been the languages of people connected ultimately or immediately with the Hebrews, who have handed down the earliest specimens of writing to posterity; and we have therefore the greatest reason to believe, that their method of writing, as well as their language, was derived from the same source.

This proposition will be farther confirmed from considering the sameness of the artificial denominations of the letters in the Oriental, Greek, and Latin languages, accompanied also by a similar arrangement, as *alpha*, *beta*, &c. It may still be objected, however, that the characters employed by the ancients to discriminate their letters are entirely dissimilar. Why should not one nation, it may be urged, adopt from the other the mode of expressing the art as well as the art itself? To what purpose did they take the trouble of inventing other characters? To this objection it may be replied, 1. From the instance of our own language we know what diversities may be introduced in this respect merely by length of time and an intercourse with neighbouring nations. And such an effect would be more likely to take place before the art of printing had contributed to establish an uniformity of character: For when every work was transcribed by the hand, we may easily imagine how many variations would arise from the fancy of the scribe, and the mode of writing so constantly different in individuals. 2. This diversity might sometimes arise from vanity. When an individual of another community had become acquainted with this wonderful art, he might endeavour to recommend himself as the inventor; and, to avoid detection, might invent other characters. 3. The cha-

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racters of the alphabet might sometimes be accommodated as much as possible to the symbolical marks already in use amongst a particular people. These having acquired a high degree of sanctity by the use of many generations, would not easily be superseded without the aid of some such contrivance. 4. This is supported by the testimony of Herodotus; who informs us, "that those Phœnicians who came with Cadmus introduced many improvements among the Greeks, and alphabetical writing too, not known among them before that period. At first they used the Phœnician character; but in process of time, as the pronunciation altered, the standard of the letters was also changed. The Ionian Greeks inhabited at the time the parts adjacent to Phœnicia: who having received the art of alphabetical writing from the Phœnicians, used it, with an alteration of some few characters, and confessed ingenuously, that it was called Phœnician from the introducers of it." He tells us that he had himself seen the characters of Cadmus in the temple of Ismenian Apollo at Thebes in Bœotia, engraven upon tripods, and very much resembling the Ionian characters. 5. The old Samaritan is precisely the same as the Hebrew language: and the Samaritan Pentateuch does not vary by a single letter in twenty words from the Hebrew: but the characters are widely different: for the Jews adopted the Chaldaic letters during their captivity at Babylon instead of the characters of their forefathers.

3. What we know of those nations who have continued for many centuries unconnected with the rest of the world, strongly militates against the hypothesis of the human invention of alphabetical writing. The experiment has been fairly made upon the ingenuity of mankind for a longer period than that which is supposed to have produced alphabetical writing by regular gradations; and this experiment determines peremptorily in their favour. The Chinese, a people famous for their discoveries and mechanical turn of genius, have made some advances towards the delineation of their ideas by arbitrary signs, but have nevertheless been unable to accomplish this exquisite device; and after so long a trial to no purpose, we may reasonably infer, that their mode of writing, which is growing more intricate and voluminous every day, would never terminate in so clear, so comparatively simple, an expedient as that of alphabetical characters. The Mexicans, too, had made some rude attempts of the same kind; but with less success than the Chinese. We know also, that hieroglyphics were in use among the Egyptians posterior to the practice of alphabetical writing by the Jews; but whether the epistolography, as it is called, of the former people, which was in vogue during the continuance of the hieroglyphics, might not possibly be another name for alphabetical writing, cannot be decided.

4. We shall consider the argument on which the commonly received supposition entirely depends: that is, the natural gradation, through the several species of symbols acknowledged to have been in use with various people, terminating at last, by an easy transition, in the detection of alphabetical characters. The strength of this argument will be best understood from the following representation.

"1. The first method of embodying ideas would be by drawing a representation of the objects themselves. The imperfection of this method is very obvious, both on account of its tediousness and its inability of going beyond external appearances to the abstract ideas of the mind.

"2. The next method would be somewhat more general, and would substitute two or three principal circumstances for the whole transaction. So two kings, for example, engaging each other with military weapons, might serve to convey the idea of a war between the two nations. This abbreviated method would be more expeditious than the former; but what it gained in conciseness would be lost in perspicuity. It is a description more compendious indeed, but still a description of outward objects alone, by drawing their resemblance. To this head may be referred the picture-writing of the Mexicans.

"3. The next advance would be to the use of symbols: the incorporation, as it were, of abstract and complex ideas in figures more or less generalized, in proportion to the improvement of it. Thus, in the earlier stages of this device, a circle might serve to express the sun, a semicircle the moon; which is only a contraction of the foregoing method. This symbol writing in its advanced state would become more refined, but enigmatical and mysterious in proportion to its refinement. Hence it would become less fit for common use, and therefore more particularly appropriated to the mysteries of philosophy and religion. Thus, two feet standing upon water served to express an impossibility; a serpent denoted the oblique trajectories of the heavenly bodies; and the beetle, on account of some supposed properties of that insect, served to represent the sun. The Egyptian hieroglyphics were of this kind.

"4. This method being still too subtle and complicated for common use, the only plan to be pursued was a reduction of the first stage of the preceding method. Thus a dot, instead of a circle, might stand for the sun; and a similar abbreviation might be extended to all the symbols. On this scheme every object and idea would have its appropriated mark: these marks, therefore, would have a multiplicity proportionable to the works of nature and the operations of the mind. This method was likewise practised by the Egyptians; but has been carried to greater perfection by the Chinese. The vocabulary of the latter is therefore infinite, or at least capable of being extended to any imaginable length. But if we compare this tedious and awkward contrivance with the astonishing brevity and perspicuity of alphabetical writing, we must be persuaded that no two things can be more dissimilar; and that the transition from a scheme constantly enlarging itself, and growing daily more intricate, to the expression of every possible idea by the modified arrangement of four-and-twenty marks, is not so very easy and perceptible as some have imagined. Indeed this seems still to be rather an expression of things in a manner similar to the second stage of symbol writing than the notification of ideas by arbitrary signs."

Additional remarks in confirmation of these arguments.

To all this we shall subjoin the following remarks, which seem to give additional force to the foregoing reasoning.

"1. Pliny asserts the use of letters to have been eternal;

nal; which ſhows the antiquity of the practice to extend beyond the era of authentic hiſtory.

" 2. The cabaliſtical doctors of the Jews maintain, that alphabetical writing was one of the ten things which God created on the evening of the Sabbath.

" 3. Moſt of the profane authors of antiquity aſcribe the firſt uſe of alphabetical characters to the Egyptians, who, according to ſome, received them from Mercury; and, according to others, from their god Teuth.

" 4. There is very little reaſon to ſuppoſe that even language itſelf is the effect of human ingenuity and invention."

Anſwers to the above arguments.

Thus we have ſtated the arguments in favour of the revelation of alphabetical writing; which are anſwered, by thoſe who take the contrary ſide, in the following manner.

1. Moſes nowhere ſays that the alphabet was a new thing in his time; nor does he give the leaſt hint of his being the inventor of it. The firſt mention we find of *writing* is in the 17th chapter of Exodus; where Moſes is commanded to *write in a book;* and which took place before the arrival of the Iſraelites at Sinai. This ſhows that writing did not commence with the delivery of the two tables of the law, as ſome have ſuppoſed. Neither are we to conclude that the invention had taken place only a ſhort time before; for the *writing in a book* is commanded as a thing commonly underſtood, and with which Moſes was well acquainted. It is plain, from the command to engrave the names of the twelve tribes of Iſrael upon ſtones *like the engravings of a ſignet*, that writing had been known and practiſed among them, as well as other nations, long before. We muſt alſo remember, that the people were commanded to write the law on their door poſts, &c. ſo that the art ſeems not only to have been known, but univerſally practiſed among them. But had writing been a new diſcovery in the time of Moſes, he would probably have commemorated it as well as the other inventions of muſic, &c.: Nor is there any reaſon to ſuppoſe that God was the immediate revealer of the art; for Moſes would never have omitted to record a circumſtance of ſuch importance, as the memory of it would have been one of the ſtrongeſt barriers againſt idolatry.

Again, Though ſeveral profane writers attribute the origin of letters to the gods, or to ſome divine perſon, yet this is no proof of its being actually revealed; but only that the original inventor was unknown. The learned biſhop of Glouceſter obſerves, that the ancients gave nothing to the gods of whoſe original they had any records; but where the memory of the invention was loſt, as of ſeed-corn, wine, writing, civil ſociety, &c. the gods ſeized the property, by that kind of right which gives ſtrays to the lord of the manor.

As neither the ſacred nor profane hiſtorians, therefore, have determined any thing concerning the invention of letters, we are at liberty to form what conjectures we think moſt plauſible concerning the origin of them; and this, it is thought, might have taken place in the following manner.

" 1. Men, in their rude uncultivated ſtate, would have neither leiſure, inclination, nor inducement, to cultivate the powers of the mind to a degree ſufficient for the formation of an alphabet: but when a people arrived at ſuch a pitch of civilization as required them to repreſent the conceptions of the mind which have no corporeal forms, neceſſity would occaſion further exertions, and urge them to find out a more expeditious manner of tranſacting their buſineſs than by picture-writing.

" 2. Theſe exertions would take place whenever a nation began to improve in arts, manufactures, and commerce; and the greater genius ſuch a nation had, the more improvements would be made in the notation of their language; whilſt thoſe people who had made leſs progreſs in civilization and ſcience, would have a leſs perfect ſyſtem of elementary characters; and perhaps advance no farther for many ages than the marks or characters of the Chineſe. Hence we may ſee, that the buſineſs of princes, as well as the manufactures and commerce of each country, would produce the neceſſity of deviſing ſome expeditious manner of communicating information to one another."

The art of writing, however, is of ſo great antiquity, and the early hiſtory of moſt nations ſo full of fable, that it muſt be extremely difficult to determine what nation or people may juſtly claim the honour of the invention. But as it is probable that letters were the produce of a certain degree of civilization among mankind, we muſt therefore have recourſe to the hiſtory of thoſe nations who ſeem to have been firſt civilized.

Claim of the Egyptians to the invention of letters.

The Egyptians have an undoubted title to a very early civilization; and many learned men have attributed the invention of letters to them. The late biſhop of Glouceſter contends, that Egypt was the parent of all the learning of Greece, and was reſorted to by all the Grecian legiſlators, naturaliſts, and philoſophers; and endeavours to prove that it was one of the firſt civilized countries on the globe. Their writing was of four kinds: 1. *Hieroglyphic;* 2. *Symbolic;* 3. *Epiſtolic;* and, 4. *Hierogrammatic.* In the moſt early ages they wrote, like all other infant nations, by pictures; of which ſome traces yet remain amongſt the hieroglyphics of Horapollo, who informs us, that they repreſented a *fuller* by a man's two feet in water; *fire*, by ſmoke aſcending, &c. But to render this rude invention leſs incommodious, they ſoon deviſed the method of putting one thing of ſimilar qualities for another.

The former was called the *curiologic*, the latter the *tropical* hieroglyphic; which laſt was a gradual improvement on the former. Theſe alterations in the manner of delineating hieroglyphic figures produced and perfected another character, called the *running-hand of the hieroglyphics*, reſembling the Chineſe writing; which having been firſt formed by the outlines of each figure, became at length a kind of *marks;* the natural effects of which were, that the conſtant uſe of them would take off the attention from the ſymbol and fix it on the thing ſignified. Thus the ſtudy of ſymbolic writing would be much abbreviated; becauſe the writer or decypherer would have then little to do but to remember the power of the ſymbolic mark; whereas before, the properties of the thing or animal delineated were to be learned. This, together with the other marks by inſtitution, to denote mental conceptions, would reduce the characters to a ſimilar ſtate with the preſent Chineſe; and theſe were properly what the ancients called *hieroglyphical.* We are informed by Dr Robert Huntingdon, in his account of the Porphyry pillars,

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pillars, that there are ſome ancient monuments of this kind yet remaining in Egypt.

The ſacred book or ritual of the Egyptians, according to Apuleius, was written partly in ſymbolic and partly in theſe hieroglyphic characters, in the following manner: "He (the hierophant) drew out certain books from the ſecret repoſitories of the ſanctuary, written in unknown characters, which contained the words of the ſacred formula compendiouſly expreſſed, partly by figures of animals, and partly by certain marks or notes intricately knotted, revolving in the manner of a wheel, crowded together, and curled inward like the tendrils of a vine, ſo as to hide the meaning from the curioſity of the profane."

Letters not invented in Egypt.

But though letters were of great antiquity in Egypt, there is reaſon to believe that they were not firſt invented in that country. Mr Jackſon, in his Chronological Antiquities, has endeavoured to prove, that they were not invented or carried into Egypt by *Taaut* or *Thoth*, the firſt Hermes, and ſon of Miſraim, who lived about 500 years after the deluge; but that they were introduced into that country by the ſecond Hermes, who lived about 400 years after the former. This ſecond Hermes, according to Diodorus, was the inventor of grammar and muſic, and added many words to the Egyptian language. According to the ſame author alſo, he invented letters, rhythm, and the harmony of ſounds. This was the Hermes ſo much celebrated by the Greeks, who knew no other than himſelf. On the other hand, Mr Wiſe aſſerts that Moſes and Cadmus could not learn the alphabet in Egypt; and that the Egyptians had no alphabet in their time. He adduces ſeveral reaſons to prove that they had none till they received what was called the *Coptic*, which was introduced either in the time of the Ptolemies or under Pſammitichus or Amaſis; and the oldeſt alphabetic letters which can be produced as Egyptian, appear plainly to have been derived from the Greek. Herodotus confeſſes, that all he relates before the reign of Pſammitichus is uncertain; and that he reports the early tranſactions of that nation on the credit of the Egyptian prieſts, on which he did not greatly depend; and Diodorus Siculus is ſaid to have been greatly impoſed upon by them. Manetho, the oldeſt Egyptian hiſtorian, tranſlated the ſacred regiſters out of Egyptian into Greek, which are ſaid by Syncellus to have been written in the ſacred letters, and to have been laid up by the ſecond Mercury in the Egyptian temples. He allows the Egyptian gods to have been mortal men; but his hiſtory was very much corrupted by the Greeks, and hath been called in queſtion by ſeveral writers from the account which he himſelf gave of it. After Cambyſes had carried away the Egyptian records, the prieſts, to ſupply their loſs, and to keep up their pretenſions to antiquity, began to write new records; wherein they not only unavoidably made great miſtakes, but added much of their own invention, eſpecially as to diſtant times.

Claim of the Phœnicians.

The Phœnicians have likewiſe been ſuppoſed the inventors of letters; and we have the ſtrongeſt proofs of the early civilization of this people. Their moſt ancient hiſtorian, Sanchoniatho, lived in the time of Abibalus, father of Hiram king of Tyre. He informs us, that letters were invented by *Taaut*, who lived in Phœnicia in the 12th and 13th generations after the creation. "Miſor (ſays he) was the ſon of Hamyn; the ſon of Miſor was *Taaut*, who invented the firſt letters for writing." The Egyptians call him *Thoth;* the Alexandrians *Thoyth;* and the Greeks *Hermes*, or *Mercury*. In the time of this Taaut or Mercury, (the grandſon of Ham the ſon of Noah), Phœnicia and the adjacent country was governed by Uranus, and after him by his ſon Saturn or Cronus. He invented letters either in the reign of Uranus or Cronus; and ſtaid in Phœnicia with Cronus till the 32d year of his reign. Cronus, after the death of his father Uranus, made ſeveral ſettlements of his family, and travelled into other parts; and when he came to the ſouth country, he gave all Egypt to the god Taautus, that it ſhould be his kingdom. Sanchoniatho began his hiſtory with the creation, and ended it with placing Taautus on the throne of Egypt. He does not mention the deluge, but makes two more generations in Cain's line from Protagonus to Agrovenus (or from Adam to Noah than Moſes. As Sanchoniatho has not told us whether Taaut invented letters either in the reign of Uranus or Cronus, "we cannot err much (ſays Mr Jackſon) if we place his invention of them 550 years after the flood, or 20 years after the diſperſion, and 2619 years before the Chriſtian era, and ſix, or perhaps ten years, before he went into Egypt." This prince and his poſterity reigned at Thebes in Upper Egypt for 15 generations.

Several Roman authors attribute the invention of letters to the Phœnicians. Pliny ſays (A), the Phœnicians were famed for the invention of letters, as well as for aſtronomical obſervations and novel and martial arts. Curtius informs us, that the Tyrian nation are related to be the firſt who either taught or learned letters; and Lucan ſays, that they were the firſt who attempted to expreſs ſounds or words by letters. Euſebius alſo tells us from Porphyry, that "Sanchoniatho ſtudied with great application the writings of Taaut, knowing that he was the firſt who invented letters."

The Greeks, as we have already obſerved, knew no older Hermes than the ſecond, who lived about 400 years after the Mezrite Taaut or Hermes. This ſecond Hermes is called by Plato *Theuth*, and counſellor or ſacred ſcribe to King Thanius; but it is not ſaid that he ever reigned in Egypt: but the former Taaut, or Athothes, as Manetho calls him, was the immediate ſucceſſor of Menes the firſt king of Egypt. This ſecond Mercury, if we may believe Manetho, compoſed ſeveral books of the Egyptian hiſtory, and having improved both the language and letters of that nation, the Egyptians attributed the arts and inventions of the former to the latter. The Phœnician language is generally allowed to have been a dialect of the Hebrew; and though their alphabet does not entirely agree with the

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(A) He ſays in another place, that the knowledge of letters is eternal. What dependance can we put in the opinion of a writer who thus contradicts himſelf?

Alphabet. the Samaritan, yet there is a great ſimilarity between them. Aſtronomy and arithmetic were much cultivated among them in the moſt early ages; their fine linen, purple, and glaſs, were much ſuperior to thoſe of other nations; and their extraordinary ſkill in architecture and other arts was ſuch, that whatever was great, elegant, or pleaſing, whether in buildings, apparel, or toys, was diſtinguiſhed by the epithet of Tyrian or Sidonian; theſe being the chief cities of Phœnicia. Their great proficiency in learning and arts of all kinds, together with their engroſſing all the commerce of the weſtern world, are likewiſe thought to give them a juſt claim to the invention of letters.

Of the Chaldeans. The Chaldeans alſo have laid claim to the invention of letters; and with regard to this, there is a tradition among the Jews, Indians, and Arabians, that the Egyptians derived their knowledge from Abraham, who was a Chaldean. This tradition is in ſome degree confirmed by moſt of the weſtern writers, who aſcribe the inventions of arithmetic and aſtronomy to the Chaldeans. Joſephus poſitively aſſerts, that the Egyptians were ignorant of the ſciences of arithmetic and aſtronomy before they were inſtructed by Abraham; and Sir Iſaac Newton admits, that letters were known in the line of that patriarch for many centuries before Moſes. The Chaldaic letters appear to have been derived from the Hebrew or Samaritan; which are the ſame, or nearly ſo, with the old Phœnician. Ezra is ſuppoſed to have exchanged the old Hebrew characters for the more beautiful and commodious Chaldee, which are ſtill in uſe. Beroſus, the moſt ancient Chaldean hiſtorian, who was born in the minority of Alexander the Great, does not ſay that he believed his countrymen to have been the inventors of letters.

Of the Syrians. The Syrians have alſo laid claim to the invention of letters. It is certain indeed, that they yielded to no nation in knowledge and ſkill in the fine arts. Their language is ſaid to have been the vernacular of all the oriental tongues, and was divided into three dialects. 1. The Aramean, uſed in Meſopotamia, and by the inhabitants of Roha and Edeſa of Harram, and the Outer Syria. 2. The dialect of Paleſtine; ſpoken by the inhabitants of Damaſcus, Mount Libanus, and the Inner Syria. 3. The Chaldee or Nabathean dialect, the moſt unpoliſhed of the three; and ſpoken in the mountainous parts of Aſſyria, and the villages of Irac or Babylonia. It has been generally believed, that no nation of equal antiquity had a more conſiderable trade than the Syrians: they are ſuppoſed to have firſt brought the commodities of Perſia and India into the weſt of Aſia; and they ſeem to have carried on an inland trade by engroſſing the navigation of the Euphrates, whilſt the Phœnicians traded to the moſt diſtant countries. Notwithſtanding theſe circumſtances, however, which might ſeem to favour the claim of the Syrians, the oldeſt characters they have are but about three centuries before Chriſt. Their letters are of two ſorts. 1. The Eſtrangelo, which is the more ancient; and, 2. The Fſhito, the ſimple or common character, which is the more expeditious and beautiful.

Of the Indians. We muſt next examine the claims of the Indians, whoſe pretenſions to antiquity yield to no other nation on earth. Mr Halhed, who has written a grammar of the Shanſcrit language, informs us, that it is not only the grand ſource of Indian literature, but the parent of almoſt every dialect from the Perſian gulf to the Chineſe ſeas, and which is ſaid to be a language of the moſt venerable antiquity. At preſent it is appropriated to religious records of the Bramins, and therefore ſhut up in their libraries; but formerly it appears to have been current over the greateſt part of the eaſtern world, as traces of its extent may be found in almoſt every diſtrict of Aſia.

Mr Halhed informs us, that "there is a great ſimilarity between the Shanſcrit words and thoſe of the Perſian and Arabic, and even of Latin and Greek; and theſe not in technical or metaphorical terms, but in the main ground-works of language; in monoſyllables, the names of numbers, and the appellations of ſuch things as would be firſt diſcriminated on the immediate dawn of civilization. The reſemblance which may be ſeen of the characters on the medals and ſignets of different parts of Aſia, the light they reciprocally throw upon one another, and the general analogy which they all bear to the grand prototype, affords another ample field for curioſity. The coins of Aſſam, Napaul, Caſhmiria, and many other kingdoms, are all ſtamped with Shanſcrit letters, and moſtly contain alluſions to the old Shanſcrit mythology. The ſame conformity may be obſerved in the impreſſions of ſeals from Bootan and Thibet."

The country between the Indus and Ganges ſtill preſerves the Shanſcrit language in its original purity, and offers a great number of books to the peruſal of the curious; many of which have been handed down from the earlieſt periods of human civilization.

There are ſeven different ſorts of Indian hand-writings, all compriſed under the general term of *Naagoree*, which may be interpreted *writing*. The Bramins ſay that letters were of divine original; and the elegant Shanſcrit is ſtyled *Daeb-naagoree*, or the writings of the Immortals, which might not improbably be a refinement from the more ſimple *Naagoree* of former ages. The Bengal letters are another branch of the ſame ſtock. The Bramins of Bengal have all their Shanſcrit books copied in their national alphabet, and they tranſpoſe into them all the Daeb-naagoree manuſcripts for their own peruſal. The Mooriſh dialect is that ſpecies of Hindoſtanic which we owe to the conqueſts of the Mahometans.

The Shanſcrit language contains about 700 radical words; the fundamental part being divided into three claſſes, viz. 1. *Dhaat*, or roots of verbs; 2. *Shubd*, or original nouns; 3. *Evya*, or particles. Their alphabet contains 50 letters; viz. 34 conſonants and 16 vowels. They aſſert that they were in poſſeſſion of letters before any other nation in the world; and Mr Halhed conjectures, that the long boaſted original civilization of the Egyptians may ſtill be a matter of diſpute. The rajah of Kiſhnagur affirms, that he has in his poſſeſſion Shanſcrit books, where the Egyptians are conſtantly deſcribed as diſciples, not as inſtructors; and as ſeeking in Hindoſtan that liberal education, and thoſe ſciences, which none of their own countrymen had ſufficient knowledge to impart. Mr Halhed hints alſo, that the learning of Hindoſtan might have been tranſplanted into Egypt, and thus have become familiar to Moſes. Several authors, however, are of opinion, that the ancient Egyptians poſſeſſed themſelves of the trade of the Eaſt by the Red ſea, and that they carried

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carried on a conſiderable traffic with the Indian nations before the time of Seſoſtris; whom they ſuppoſe to have been cotemporary with Abraham, though Sir Iſaac Newton conjectures him to have been the Shiſhak who took Jeruſalem in the time of Rehoboam.

In the year 1769, one of the ſacred books of the Gentoos called *Bagavadam*, tranſlated by Meridas-Poule, a learned man of Indian origin, and chief interpreter to the ſupreme council of Pondicherry, was ſent by him to M. Berten in France. In his preface he ſays, that it was compoſed by Viaſſar the ſon of Brahma, and is of ſacred authority among the worſhippers of Viſchnow. This book claims an antiquity of 5000 years; but M. de Guines has ſhown, that its pretenſions to ſuch extravagant antiquity are entirely inconcluſive and unſatisfactory: whence we may conclude, ſays Mr Aſtle, that though a farther inquiry into the literature of the Indian nations may be laudable, yet we muſt by no means give too eaſy credit to their relations concerning the high antiquity of their manuſcripts and early civilization.

Letters not invented in Perſia;

It is not pretended that the Perſians had any great learning among them till the time of Hyſtaſpes the father of Darius. The former, we are told, travelled into India, and was inſtructed by the Bramins in the ſciences for which they were famed at that time. The ancient Perſians deſpiſed riches and commerce, nor had they any money among them till after the conqueſt of Lydia. It appears by ſeveral inſcriptions taken from the ruins of the palace of Perſepolis, which was built near 700 years before the Chriſtian era, that the Perſians ſometimes wrote in perpendicular columns like the Chineſe. This mode of writing was firſt made uſe of on the ſtems of trees, pillars, or obeliſks. As for thoſe ſimple characters found on the weſt ſide of the ſtaircaſe of Perſepolis, ſome have ſuppoſed them to be alphabetic, ſome hieroglyphic, and others antediluvian. Dr Hyde pronounces them to have been mere whimſical ornaments, though the author of Conjectural Obſervations on Alphabetic Writing ſuppoſes them to be fragments of Egyptian antiquity brought by Cambyſes from the ſpoils of Thebes. The learned are generally agreed, that the Perſians were later in civilization than many of their neighbours; and they are not ſuppoſed to have any pretenſions to the invention of letters.

As the Arabians have been in poſſeſſion of the country they now inhabit for upwards of 3700 years, without being intermixed with foreign nations, or ſubjugated by any other power, their language muſt be very ancient. The two principal dialects of it were that ſpoken by the Hamyarites and other genuine Arabs; and that of the Koreiſh, in which Mahomet wrote the Alcoran. The former is named by oriental writers, the *Arabic of Hamyar;* the latter, *the pure* or *defecated Arabic*. Mr Richardſon obſerves, as a proof of the richneſs of this language, that it conſiſts of 2000 radical words.

nor by the Arabians.

The old Arabic characters are ſaid to have been of very high antiquity; for Ebn Haſhem relates, that an inſcription in it was found in Yaman as old as the days of Joſeph. Hence ſome have ſuppoſed, that the Arabians were the inventors of letters; and Sir Iſaac Newton is of opinion, that Moſes learned the alphabet from the Midianites, who were Arabians.

The alphabet of the Arabs conſiſts of 28 letters ſimilar to the ancient Cufic, in which the firſt copies of the Alcoran were written. The preſent Arabic characters were formed by Ebn Moklah, a learned Arabian who lived about 300 years after Mahomet. The Arabian writers themſelves inform us, that their alphabet is not very ancient, and that they received it only a ſhort time before the introduction of Iſlamiſm.

On this account of the pretenſions of different nations to the invention of letters, Mr Aſtle makes the following reflections: "The vanity of each nation induces them to pretend to the moſt early civilization: but ſuch is the uncertainty of ancient hiſtory, that it is difficult to determine to whom the honour is due. It ſhould ſeem, however, that the conteſt may be confined to the Egyptians, the Phœnicians, and the Chaldeans. The Greek writers, and moſt of thoſe who have copied them, decide in favour of Egypt, becauſe their information is derived from the Egyptians themſelves. The poſitive claim of the Phœnicians does not depend entirely upon the teſtimony of Sanchoniatho; the credit of his hiſtory is ſo well ſupported by Philo of Byblus his tranſlator, Porphyry, Pliny, Curtius, Lucan, and other ancient writers, who might have ſeen his works entire, and whoſe relations deſerve at leaſt as much credit as thoſe of the Egyptian and Greek writers. It muſt be allowed, that Sanchoniatho's hiſtory contains many fabulous accounts; but does not the ancient hiſtory of the Egyptians, the Greeks, and moſt other nations, abound with them to a much greater degree? The fragments which we have of this moſt ancient hiſtorian are chiefly furniſhed by Euſebius, who took all poſſible advantages to repreſent the Pagan writers in the worſt light, and to render their theology abſurd and ridiculous.

Letters moſt probably invented in Phœnicia.

"The Phœnician and Egyptian languages are very ſimilar; but the latter is ſaid to be more large and full, which is an indication of its being of a later date. The opinion of Mr Wiſe, however, that the ancient Egyptians had not the knowledge of letters, ſeems to be erroneous; as they had commercial intercourſe with their neighbours the Phœnicians, they probably had the knowledge of letters, if their policy, like that of the Chineſe at this day, did not prohibit the uſe of them.

"The Chaldeans, who cultivated aſtronomy in the moſt remote ages, uſed ſymbols or arbitrary marks in their calculations; and we have ſhewn that theſe were the parents of letters. This circumſtance greatly favours their claim to the invention: becauſe Chaldea, and the countries adjacent, are allowed by all authors, both ſacred and profane, to have been peopled before Egypt; and it is certain, that many nations ſaid to be deſcended from Shem and Japheth, had their letters from the Phœnicians, who were deſcended from Ham.

"It is obſervable that the Chaldeans, the Syrians, Phœnicians, and Egyptians, all bordered upon each other; and as the Phœnicians were the greateſt as well as the moſt ancient commercial nation, it is very probable that they communicated letters to the Egyptians, the ports of Tyre and Sidon being not far diſtant from each other.

"Mr Jackſon is evidently miſtaken when he ſays that letters were invented 2619 years before the birth of Chriſt. The deluge recorded by Moſes was 2349 years

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years before that event; and if letters were not invented till 550 years after, as he asserts, we must date their discovery only 1799 years before the Christian era, which is 410 years after the reign of Menes, the first king of Egypt, who, according to Syncellus and others, is said to have been the same person with the Misor of Sanchoniatho, the Mizraim of the Scriptures, and the Osiris of the Egyptians; but whether this be true or not, Egypt is frequently called in Scripture *the land of Mizraim*.

"This Mizraim, the second son of Amyn or Ham, seated himself near the entrance of Egypt at Zoan, in the year before Christ 2188, and 160 years after the flood. He afterwards built Thebes, and some say Memphis. Before the time that he went into Egypt, his son Taaut had invented letters in Phœnicia; and if this invention took place ten years before the migration of his father into Egypt, as Mr Jackson supposes, we may trace letters as far back as the year 2178 before Christ, or 150 years after the deluge recorded by Moses; and beyond this period, the written annals of mankind, which have been hitherto transmitted to us, will not enable us to trace the knowledge of them; though this want of materials is no proof that letters were not known until a century and a half after the deluge. As for the pretensions of the Indian nations, we must be better acquainted with their records before we can admit of their claim to the first use of letters; especially as none of their manuscripts of any great antiquity have as yet appeared in Europe. That the Arabians were not the inventors of letters, has appeared by their own confession. Plato somewhere mentions Hyperborean letters very different from the Greek; these might have been the characters used by the Tartars, or ancient Scythians.

Of Antediluvian writing.

"It may be expected that something should be said concerning those books mentioned by some authors to have been written before the deluge. Amongst others, Dr Parsons, in his Remains of Japheth, p. 346, 359, supposes letters to have been known to Adam; and the Sabeans produce a book, which they pretend was written by Adam. But concerning these we have no guide to direct us any more than concerning the supposed books of Enoch; some of which, Origen tells us, were found in Arabia Felix, in the dominions of the queen of Saba. Tertullian affirms, that he saw and read several pages of them: and, in his treatise *De Habitu Mulierum*, he places those books among the canonical: but St Jerome and St Austin look upon them to be apocryphal. William Postellus pretended to compile his book, *De Originibus*, from the book of Enoch; and Thomas Bangius published at Copenhagen, in 1657, a work which contains many singular relations concerning the manner of writing among the Antediluvians, which contains several pleasant stories concerning the books of Enoch.

"With regard to this patriarch, indeed, St Jude informs us that he *prophesied*, but he does not say that he *wrote*. The writings, therefore, attributed to the Antediluvians, must appear quite uncertain; though it might be improper to assert that letters were unknown before the deluge recorded by Moses."

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All the alphabets in the world cannot be proved to arise from one original.

Our author proceeds to show, that all the alphabets in the world cannot be derived from one original: because there are a variety of alphabets used in different parts of Asia, which vary in name, number, figure, order, and power, from the Phœnician, ancient Hebrew, or Samaritan. In several of these alphabets also, there are marks for sounds peculiar to the language of the East, which are not necessary to be employed in the notation of the languages of Europe.

None of the alphabets to the east of Persia have any connexion with the Phœnician or its derivatives, except where the Arabic letters have been introduced by the conquests of the Mahometans. The foundation of all the Indian characters are those called *Shanscrit* or *Sungscrit*. This signifies something brought to perfection, in contradistinction to *prakrit*, which signifies vulgar or unpolished. Hence the refined and religious language and characters of India are called *Sungscrit*, and the more vulgar mode of writing and expression *Prakrit*. From this Shanscrit are derived the sacred characters of Thibet, the Cashmirian, Bengalese, Malabaric, and Tamoul; the Singalese, Siamese, Maharattan, Concanee, &c. From the same source we may derive the Tangutic or Tartar characters, which are similar in their great outlines to the Shanscrit; though it is not easily determined which is derived from the other. The common Tartar is generally read, like the Chinese, from top to bottom.

There are, however, several alphabets used in different parts of Asia, entirely different not only from the Shanscrit and all those derived from it, but also from the Phœnician and those which proceed from it. Some of these are the alphabet of Pegu, the *Batta* characters used in the island of Sumatra, and the *Barman* or *Boman* characters used in some parts of Pegu. The names and powers of the letters of which these alphabets are composed, differ entirely from the Phœnician, or those derived from them. It is impossible to assimilate their forms; and indeed it is by no means easy to conceive how the 50 letters of the Shanscrit language could be derived from the Phœnician alphabet, which consisted originally only of 13; though it is certain, that by far the greater number of alphabets now in use are derived from the ancient Hebrew, Phœnician, or Samaritan.

Alphabets derived from the Phœnician.

Mr Astle next proceeds to consider what alphabets are derived from the Phœnician. These he supposes to have been immediately the ancient Hebrew or Samaritan; the Chaldaic; the Bastulian (A) or Spanish Phœnician; the Punic, Carthaginian, or Sicilian; and the Pelasgian. From the ancient Hebrew proceeded the Chaldaic or square Hebrew; the round Hebrew; and what is called the *running hand of the Rabbins*. The Pelasgian gave birth to the Etruscan, Eugubian or Umbrian, Oscan, Samnic, and Ionic Greek, written from the left. From the Chaldaic or square Hebrew are derived the Syriac, and the ancient and modern Arabic. The Syriac is divided into the Estrangelo and

(A) The Bastuli are said to have been a Canaanitish or Phœnician people who fled from Joshua, and settled afterwards in Spain.

and Mendæan, and the modern Arabic has given rise to the Persian and Turkish. From the ancient Arabic are derived the Cufic or Oriental, the Mauritanic or Occidental, the African or Saracen, and the Moorish. The Ionic Greek gave rise to the Arcadian, Latin, ancient Gaulish, ancient Spanish, ancient Gothic, Coptic, Ethiopic, Russian, Illyrian or Sclavonic, Bulgarian, and Armenian. From the Roman are derived the Lombardic, Visigothic, Saxon, Gallican, Franco-Gallic or Merovingian, German, Caroline, Capetian, and modern Gothic.

The Punic letters are also called *Tyrian*, and were much the same with the Carthaginian or Sicilian. The Punic language was at first the same with the Phœnician; it is nearly allied to the Hebrew, and has an affinity with the Chaldee and Syriac. Some remains of it are to be met with in the Maltese. To make a complete Punic, Carthaginian, or Sicilian alphabet, we must admit several pure Phœnician letters.

The Pelasgi were likewise of Phœnician original; and, according to Sanchoniatho, the Dioscuri and Cabiri wrote the first annals of the Phœnician history, by order of Taaut, the inventor of letters. They made ships of burthen; and being cast upon the coast near Mount Casius, about 40 miles from Pelusium, where they built a temple in the second generation after the deluge related by Moses, they were called *Pelasgi*, from their passing by sea, and wandering from one country to another. Herodotus informs us, that the Pelasgi were descendants of the Phœnician Cabiri, and that the Samothracians received and practised the Cabiric mysterics from them. The Pelasgic alphabet prevailed in Greece till the time of Deucalion, when the Pelasgi were driven out of Thessaly or Oenotria by the Hellenes; after which some of them settled at the mouth of the Po, and others at Croton, now *Cortona* in Tuscany. Their alphabet consisted of 16 letters, and the Tyrrhenian alphabet, brought into Italy before the reign of that prince consisted of no more than 13. Deucalion is said to have reigned about 820 years after the deluge, and 1529 before the Christian era.

That the Tyrrheni, Tyrseni or Hetrusci, settled in Italy long before this period, appears from the testimony of Herodotus, who informs us, that a colony went by sea from Lydia into Italy under Tyrrhenus; and Dionysius of Halicarnassus proves that many authors called them Pelasgi. He then cites Hellanicus Lesbicus, an author somewhat more ancient than Herodotus, to prove, that they were first called *Pelasgi Tyrrheni*; and when they passed into Italy, they settled in that part of it called *Etruria*. Their emigration took place about the year of the world 2011, or 1993 years before the Christian era, which is 350 years before the Pelasgi left Greece. Bishop Cumberland adduces many proofs to show that the Tyrrhenians originally came out of Lydia into Italy. Several Roman authors also speak of this Lydian colony; and Horace compliments his patron Mæcenas upon his Lydian descent:

Lydorum quicquid Etruscos
Incoluit fines, nemo generosior est te.

The Etruscan letters are Pelasgic, and several of the Etruscan inscriptions are written in the Pelasgic language. The Roman letters are Ionic. The Oscan language was a dialect of the Etruscan; their characters are nearer the Ionic or Roman than the Etruscan. There is also very little difference between the Pelasgian, Etruscan, and most ancient Greek letters, which are placed from right to left. The Arcadians were ancient Greeks, and used the Ionic letters; but at what time they began to write from left to right is not known, as their chronology is very uncertain. The Etruscan, Oscan, and Samnite alphabets, are derived from the Pelasgic; they differ from each other more in name than in form; but a far greater number are derived from the Ionic Greek, namely, the Arcadian, the Latin or Roman, and the others already enumerated.—The Runic is immediately derived from the Gothic.

According to Dionysius of Halicarnassus, the first Greek colony which came into Italy consisted of Arcadians, under the conduct of Oenotrus, the son of Lycaon, and fifth in descent from Phoroneus, the first king of Argos, who reigned about 566 years before the taking of Troy, and 1750 years before the Christian era. These Oenotrians were called *Aborigines*; and after they had been engaged for many years in a war with the Siculi, entered into an alliance with a colony of the Pelasgi, who came out of Thessaly into Italy, after having been driven from the former country. About 1476 B. C. another colony of the Pelasgi, who had been driven out of Thessaly by the Curetes and Leleges, arrived in Italy, where they assisted the Aborigines to drive out the Siculi, possessing themselves of the greatest part of the country between the Tiber and the Liris, and building several cities. Solinus and Pliny tell us, that the Pelasgi first carried letters into Italy; and the latter distinguishes between the Pelasgi and the Arcades; so the letters first carried into Italy were not the Ionic Greek, but those more ancient Pelasgic characters which the Pelasgi carried with them before Deucalion and Cadmus are said to have come into Bœotia and Thessaly. The story of Cadmus is much involved in fable; but it is agreed by most of the ancients, that the children of Agenor, *viz.* Cadmus, Europa, Phœnix, and Cilix, carried with them a colony, composed of Phœnicians and Syrians, into Asia Minor, Crete, Greece, and Libya, where they introduced letters, music, poetry, and other arts, sciences, and customs, of the Phœnicians.

Dionysius enumerates the following Greek colonies which came into Italy: 1. The Aborigines under Oenotrus, from Arcadia. 2. The Pelasgic colony, which came from Hœmonia or Thessaly. 3. Another Arcadian colony, which came with Evander from Palantium. 4. Those who came from Peloponnesus with Hercules; and 5. Those who came with Æneas from Troy. It is not easy to discover when the Ionic way of writing from left to right was introduced into Italy; but it is certain, that it did not universally prevail even in Greece till several ages after it was found out. The Athenians did not comply with it till the year of Rome 350; nor was it practised by the Samnites even in the 6th century of that city, or 230 years before Christ: for M. Gæbelin, Vol. VI. Pl. 2. gives us the Samnite alphabet of that century, wherein the letters are placed from right to left; although the Ionic way of writing prevailed in some parts of Italy in the third century of Rome. "In time (says Pliny) the tacit consent of all nations

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nations agreed to uſe the Ionic letters. The Romans conſented to this mode about the time of Tarquinius Priſcus, their fifth king." The letters brought by Demaratus the Corinthian, the father of Tarquin, Mr Wiſe thinks, muſt have been the new or Ionic alphabet, and not the ſame with that brought by Evander 500 years before. After the Romans had eſtabliſhed the uſe of the Ionic letters, they ſeem not to have acknowledged the Pelaſgian and Etruſcan to have been Greek alphabets: the moſt learned of them knew none older than the Ionic, as appears from the Greek Farneſe inſcriptions of Herodes Atticus. This learned man, out of a regard to antiquity, cauſed the oldeſt orthography to be obſerved in the writing, and the letters to be delineated after the moſt antique forms that could be found; and they are plainly no other than the Ionic or right-handed characters.

See Plates XV. and XVI. for ſpecimens of the ancient alphabets here enumerated.

The ancient Gauliſh letters are derived from the Greek, and their writing approaches more nearly to the Gothic than that of the Romans: this appears by the monumental inſcription of Gordian, meſſenger of the Gauls, who ſuffered martyrdom in the third century, with all his family. Theſe ancient Gauliſh characters were generally uſed by that people before the conqueſt of Gaul by Cæſar; but after that time the Roman letters were gradually introduced. The ancient Spaniards uſed letters nearly Greek before their intercourſe with the Romans. The ancient Gothic alphabet was very ſimilar to the Greek, and is attributed to Ulphilas, biſhop of the Goths, who lived in Mæſia about 370 years after Chriſt. He tranſlated the Bible into the Gothic tongue. This circumſtance might have occaſioned the tradition of his having invented theſe letters; but it is probable that theſe characters were in uſe long before this time. The Runic alphabet is derived from the ancient Gothic.

The Coptic letters are derived immediately from the Greek. Some have confounded them with the ancient Egyptian; but there is a very material difference between them. The Ethiopic alphabet is derived from the Coptic.

The alphabet proceeding from that of the Scythians eſtabliſhed in Europe, is the ſame with what St Cyril calls the *Servien*. The Ruſſian, Illyrian, or Sclavonic, and the Bulgarian, are all derived from the Greek. The Armenian letters differ very much from the Greek, from which they are derived, as well as from the Latin.

Alphabets derived from the Latin.

With regard to the alphabets derived from the Latin, the Lombardic relates to the manuſcripts of Italy; the Viſigothic to thoſe of Spain; the Saxon to thoſe of England; the Gallican and Franco-Gallic or Merovingian to the manuſcripts of France; the German to thoſe of that country; and the Caroline, Capetian, and Modern Gothic, to all the countries of Europe who read Latin. The firſt ſix of theſe alphabets are before the age of Charlemagne, the laſt three poſterior to it. They are more diſtinguiſhed by their names than the forms of their characters; and the former indicate all of them to have been of Roman extraction. Each nation, in adopting the letters of the Romans, added a taſte and manner peculiar to itſelf; which obviouſly diſtinguiſhed it from the writings of all other people; whence aroſe the differences between the writings of the Lombards, Spaniards, French, Saxons, Germans and Goths, and all the ſtrange terms obſervable in the writings of the Francic Gauls or Merovingians; and thoſe of the Carlovingians, their ſucceſſors, may be traced from the ſame ſource. From theſe diſtinctions the name of *national writing* was derived.

The writing of Italy was uniform till the irruption of the Goths, who disfigured it by their barbarous taſte. In 569, the Lombards, having poſſeſſed themſelves of all Italy, excepting Rome and Ravenna, introduced that form of writing which goes under their name; and as the popes uſed the Lombardic manner in their bulls, the name of *Roman* was ſometimes given to it in the 11th century; and though the dominion of the Lombards continued no longer than 206 years, the name of their writing continued in Italy from the 7th to the 13th century, and then ceaſed; when learning, having declined in that as well as in other countries, the manner of writing degenerated into the modern Gothic.

The Viſigoths introduced their form of writing into Spain, after having overrun that country; but it was aboliſhed in a provincial ſynod, held at Leon in 1091, when the Latin characters were eſtabliſhed for all public inſtruments, though the Viſigothic were uſed in private writings for three centuries afterwards.

The Gauls, on being ſubjected by the Romans, adopted their manner of writing; but by ſubſequent additions of their own, their characters were changed into what is called the *Gallican* or *Roman Gallic* mode. This was changed by the Franks into the *Franco-Gallic* or *Merovingian* mode of writing, being practiſed under the kings of the Merovingian race. It took place towards the cloſe of the ſixth century, and continued till the beginning of the ninth.

The German mode of writing was improved by Charlemagne; and this improvement occaſioned another diſtinction in writing, by introducing the alphabet named *Caroline*, which declined in the 12th century, and was ſucceeded in the 13th by the modern Gothic. In France it had degenerated by the middle of the 10th century, but was reſtored in 987 by Hugh Capet, whence it obtained the name of *Capetian*. It was uſed in England, as well as Germany and France.

The modern Gothic, which ſpread itſelf all over Europe in the 12th and 13th centuries, is improperly named, as not deriving its origin from the writing anciently uſed by the Goths. It is, however, the worſt and moſt barbarous way of writing, and originated among the ſchoolmen in the decline of the arts; being indeed nothing elſe than Latin writing degenerated. It began in the 12th century, and was in general uſe, eſpecially among monks and ſchoolmen, in all parts of Europe, till the reſtoration of arts in the 15th century, and continued longer in Germany and the northern nations. Our ſtatute books are ſtill printed in Gothic letters. The moſt barbarous writing of the ſeventh, eighth, and ninth centuries, was preferable to the modern Gothic. It is diverſified in ſuch a manner as can ſcarce admit of deſcription; and the abbreviations uſed by the writers were ſo numerous, that it became very difficult to read it; which was one of the great cauſes of the ignorance of thoſe times. Along with this, however,

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however, the Lombardic, Gothic, Roman, Caroline, and Capetian modes of writing, were occafionally ufed by individuals.

The idea that all the alphabets above mentioned are derived from the Roman, tends to prove the diftinction of national writing, and is of great ufe in difcovering the age of manufcripts: for though we may not be able exactly to determine the time when a manufcript was written, we may be able nearly to afcertain its age. For example, if a writing is Merovingian, it may be declared not to be pofterior to the 9th, nor prior to the 5th, century. If another be Lombardic, it may be affirmed to be pofterior to the middle of the 6th, and prior to the 13th. Should it be Saxon, it cannot be of an earlier date than the 7th, nor later than about the middle of the 12th.

Letters could not take place but from a decompofition of language.

Having confidered whence the alphabets now in ufe throughout the various nations of the world are derived, it remains to fay fomething concerning them as the elements of words, or how far they are capable of expreffing thofe founds which, by proper combination and arrangement, conftitute articulate language. The number of fimple founds in any language cannot be very numerous; and it is plainly thefe fimple founds alone that we have occafion to reprefent by alphabetical characters. Hence the perfon who firft invented letters muft have been capable of analyzing language in a manner which feems by no means eafy to do, and concerning which even the learned among ourfelves are not yet agreed. It is this difficulty which has produced the great diverfity in the number of alphabetical characters ufed by different nations; and where we fee a vaft number of them ufed, we may account the writing not the better, but much the worfe for it; and whoever the pretended inventor was, it is more reafonable to fuppofe that he disfigured an alphabet already invented, by unneceffary additions, than that he was the author of one himfelf.

Probably not the refult of a progreffive evolution of the human powers.

When we confider alphabetical characters as thus refulting from an analyfis of language, it will by no means appear probable that it was derived from a gradual and progreffive operation of the human mind through many ages. There is not the leaft affinity betwixt reprefenting any object by a picture and finding out the founds which compofe the word by which it is expreffed: nor, though a nation had been in ufe to reprefent things either in this method, or by any kind of arbitrary marks, for thoufands of years, could the one ever have led to the other. Arbitrary marks muft always be the fame with pictures in this refpect, that they muft always be fixed to particular objects, and thus be increafed *ad infinitum*. Letters, on the other hand, are indifferent to all objects; and therefore, by their combinations, which are more numerous than as many arbitrary marks as we could remember, may exprefs all the objects in nature. This might furnifh an argument of fome ftrength for the divine revelation of writing, were it not that other arts, feemingly as ufeful, and as difficult to be invented, had not been exprefsly afcribed to particular perfons whom we cannot fuppofe to have been divinely infpired. Thus metallurgy, mufic, the keeping of cattle, and ufe of tents, are all afcribed to a fingle family; and though writing be not exprefsly mentioned as an invention in Scripture, there is no reafon to have recourfe to a revelation for it as long as the human faculties are known to have been fufficient for the invention of it. Neverthelefs, if we take a review of the different arts which mankind have invented, we fhall find, that few of them refulted from any gradual progrefs or evolution of the powers of the human mind, but rather by fome fudden and almoft unaccountable turn of thought in an individual. Thus, the art of printing, little inferior in its utility to that of writing, lay hid for ages, and was at laft invented we fcarce know how; fo that if one inclined to fuppofe this a divine revelation, he could be at little lofs for arguments to fupport his hypothefis. This was what all the inventions and evolutions of human powers fince the creation had never been able to accomplifh; yet nobody believes that it required fupernatural abilities to be the author of this art, becaufe we fee plainly that it might have occurred to the human mind from various fources, and are furprifed that it did not occur long before. In like manner, the method of accounting for the celeftial motions by the united forces of projection and gravitation, was no refult of the progrefs that mankind had made in fcience, but luckily occurred to Mr Horrox, without any thing that we know to direct him, or perhaps from caufes almoft unknown to himfelf. Thus, alfo, the fteam engine, aeroftation, &c. were fuddenly invented only by a flight review of principles well known before, and which had been a thoufand times overlooked by thofe who might have invented both. Alphabetic writing, therefore, might have been no deduction from hieroglyphic or picture writing, from which it is effentially different; and it feems to be fome confirmation of this, that all nations who ever pretended to the invention of letters, have afcribed it to the labours of one particular perfon, without taking notice of the progrefs made towards it in preceding ages.

Of the elementary founds of language.

The learned author of Hermes informs us, that to about 20 plain elementary founds we owe that variety of articulate voices which have been fufficient to explain the fentiments of fuch an innumerable multitude as all the paft and prefent generations of men. Mr Sheridan fays, that the number of fimple founds in our tongue is 28; while Dr Kenrick fays, that we have only 11 diftinct fpecies of articulate founds, which even by contraction, prolongation, and compofition, are increafed only to the number of 16; every fyllable or articulate found in our language being one of the number. Bifhop Wilkins and Dr William Holder fpeak of 33 diftinct founds.

After the analyfis or decompofition of language into the elementary founds, the next towards the notation of it by alphabetical characters, would be the delineation of a feparate mark or letter to reprefent each found; which marks, though few in number, would admit of fuch a variety of arrangements and combinations, as might be capable of producing that infinity of articulate founds which compofe language. The ingenious Wachter, in his *Naturæ et Scripturæ Concordia*, p. 64. endeavours to fhow, that ten marks or characters are fufficient for this purpofe. His fcheme is as follows:

Alphabet.

Genus.	Figura.	Poteſtas.
Vocal.	○	a. e. i. o. u.
Guttural.	⫯	k. c. ch. q. g. h.
Lingual.	∠	l.
Lingual.	≤	d. t.
Lingual.	⊐	r.
Dental.	⊓	ſ.
Labial.	3	b. p.
Labial.	ɱ	m.
Labial.	⊑	s. ph. v. w.
Naſal.	ʌ	n.

If this is the caſe, then the moſt ſimple alphabet, which conſiſted only of 13 letters, muſt have been abundantly ſufficient to anſwer all the purpoſes of mankind, and much of our twenty-four letter alphabet may appear ſuperfluous. That able mathematician Tacquet has calculated the various combinations of the 24 letters, even without any repetition, to amount to no fewer than 620,448,401,733,239,439,360,000; while Clavius makes them only 5,852,616,738,497,664,000. Either of theſe numbers, however, is *infinite* to the human conceptions, and much more than ſufficient to expreſs all the ſounds that ever were articulated by man.

Number of letters in different alphabets.

As there are more ſounds in ſome languages than in others, it follows of courſe, that the number of elementary characters or letters muſt vary in the alphabets of different languages. The Hebrew, Samaritan, and Syriac alphabets, have 22 letters; the Arabic 28; the Perſian, and Egyptian or Coptic, 32; the preſent Ruſſian 41; the Shanſcrit 50; while the Caſhmirian and Malabaric are ſtill more numerous. The following is the ſcheme of the Engliſh alphabet, as given by Mr Sheridan in his Rhetorical Grammar, p. 9.

Number of ſimple ſounds in our tongue 28.

	3	1	2	3	2	3	1	1	1
9 *Vowels*,	a	a	a	e	o	o	e	i	u
	hall	hat	hate	beer	note	nooſe	bet	fit	but

w — ſhort oo; y — ſhort ee

19 *Conſonants*, { eb ed ef eg ek el em en ep er es et ev ez eth̄ eth eſh ezh ing.

2 *Superfluous*, *c*, which has the power of *ek* or *eſs*: *q*, that of *ek* before *u*.

2. *Compound*, *j*, which ſtands for *edzh*; *x*, for *ks* or *gz*.

1. *No letter*, *h*, merely a mark of aſpiration.

Conſonants divided into Mutes and Semivowels.

6 *Mutes*, eb ed eg ek ep et.
3 *Pure Mutes*, ek ep et.
3 *Impure*, eb ed eg.

13 *Semivowels or liquids*, } ef el em en er eſs ev ez eth̄ eth eſh ezh ing.

9 *Vocal*, el em en er ev ez eth ezh ing.
4 *Aſpirated*, ef eſs eth̄ eſh.

Divided again into

4 *Labial*, eb ep ev ef.
8 *Dental*, ed et eth eth ez eſs ezh eſh.
4 *Palatine*, eg ek el er.
3 *Naſal*, em en ing.

Imperfection in the Engliſh alphabet.

Mr Sheridan obſerves, that our alphabet is ill calculated for the notation of the Engliſh tongue, as there are many ſounds for which we have no letters or marks: and there ought to be nine more characters or letters to make a complete alphabet, in which every ſimple ſound ought to have a mark peculiar to itſelf. The reaſon of the deficiency is, that the Roman alphabet was formerly adopted for the notation of the Engliſh language, though by no means ſuited to the purpoſe.

Of the forms of letters.

It now remains only to take ſome notice of the forms of the different letters; ſome knowledge of which is abſolutely neceſſary for aſcertaining the age and authenticity of inſcriptions, manuſcripts, charters, and ancient records. Many authors are of opinion, that letters derive their forms from the poſitions of the organs of ſpeech in their pronunciation. Van Helmont has taken great pains to prove, that the Chaldaic characters are the genuine alphabet of nature; becauſe, according to him, no letter can be rightly ſounded without diſpoſing the organs of ſpeech into an uniform poſition with the figure of each letter; and in ſupport of this ſyſtem, he has anatomiſed the organs of articulation.

Mr Nelme has endeavoured to ſhow, that all elementary characters or letters derive their forms from the line and the circle. His alphabet conſiſts of 13 radical letters, four diminiſhed and four augmented.—The radicals are L, O, S, A, B, C, D, N, U, I, E, M, R.—H, according to him, is derived from A; P from B; T from D; and F from U: theſe are called diminiſhed letters. The augmented ones are, Z from S; G from C; W from U; and Y from I. He proves that his characters are very ſimilar to thoſe of the ancient Etruſcans: but all characters are compoſed either of lines and circles of the former, or of parts of the latter.—Mr Gebelin deduces them from hieroglyphic repreſentations; and has given ſeveral delineations of human figures, trees, &c. in confirmation of his hypotheſis.

One of the moſt ſimple alphabets has been formed by making two perpendicular and two horizontal lines:

Thus,

a|b|c
d|e|f
g|h|i.

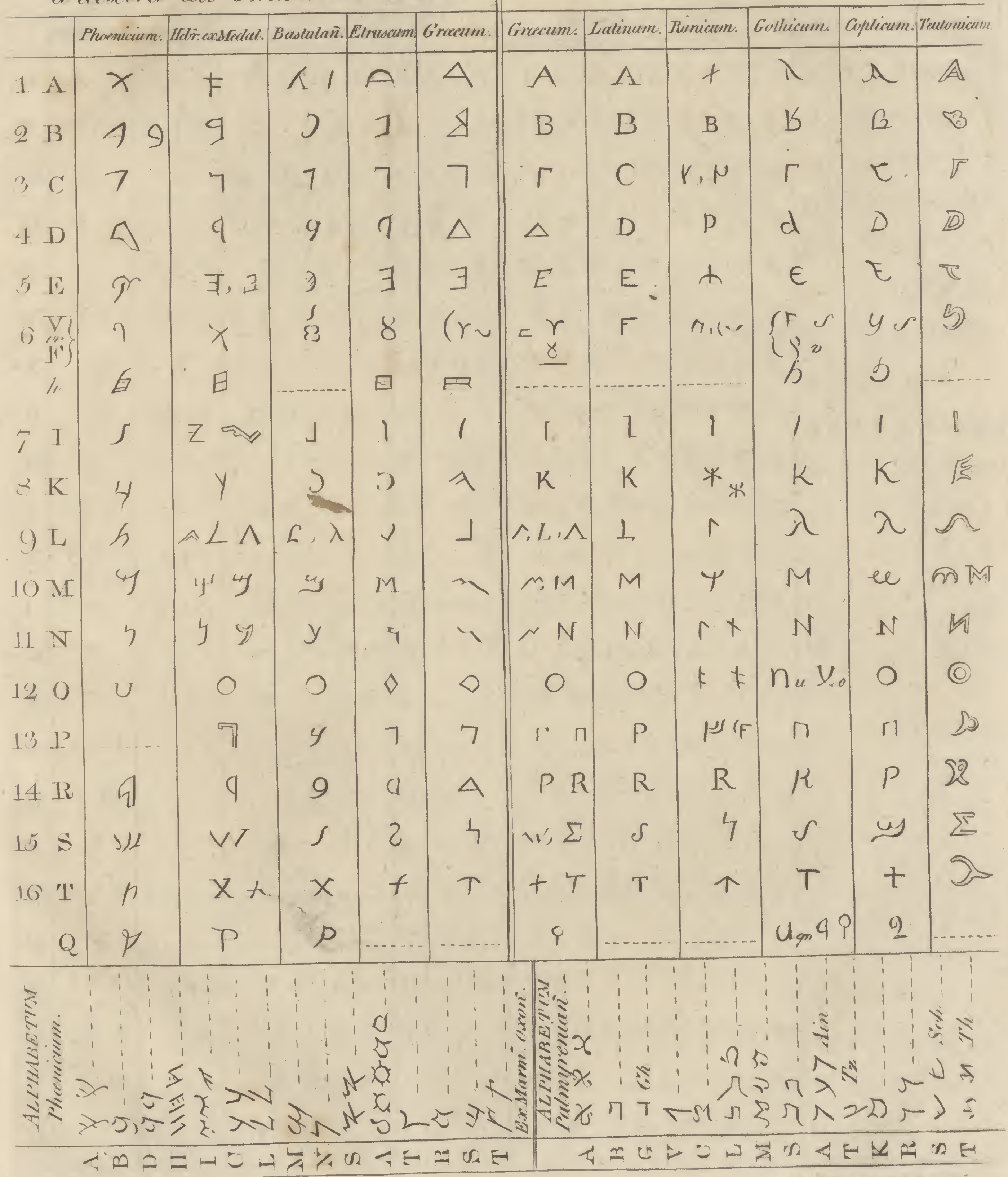
From which may be deduced nine different characters or letters: Thus,

a| |b| |c d| |e| |f g| |h| |i.

Nine

ALPHABETA ANTIQUISSIMA.

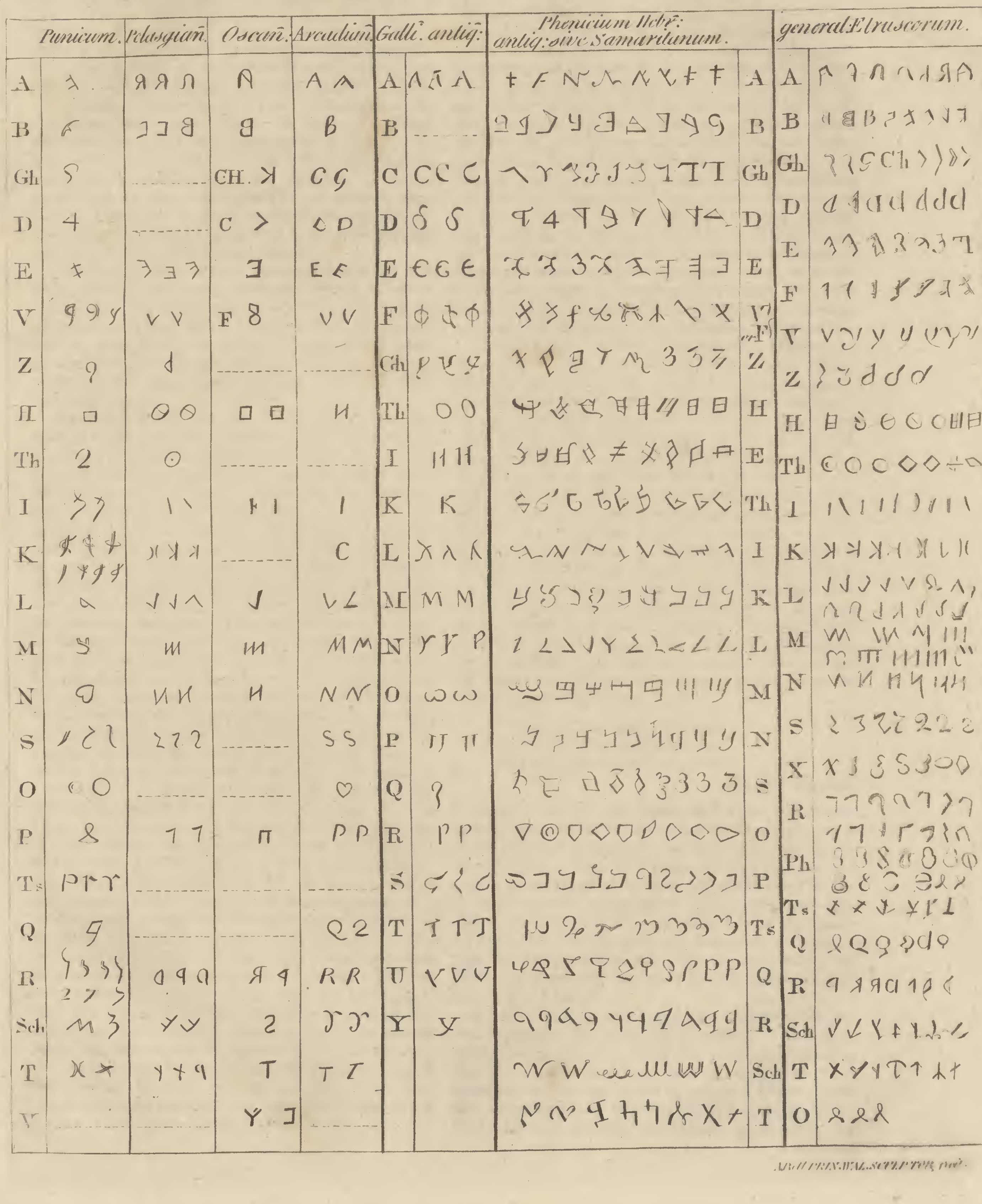
a dextra ad sinistram exarat. — *a sinistra ad dextram.*



A.Bell PRIN.WAL.SCULPTOR fecit.

ALPHABETA ANTIQUA.

Plate XVI.



Nine more may be made by adding a point to each,

k | l | m

and as many more as n | o | p may be ſufficient for the

q | r | s

notation of any language, by adding two or more points to each character. Though theſe ſquare characters are not calculated for deſpatch; yet they may be made as expeditiouſly, or more ſo, than the Tartar, the Bramin, the Caſhmirian, or many others. Writing compoſed of theſe characters, is at firſt ſight ſomewhat like the Hebrew.—Mr Dow, author of the hiſtory of Indoſtan, lately formed a new language and alphabet. This language, and the characters formed for its notation, were ſo eaſy, that a female of his acquaintance acquired the knowledge of them in three weeks, and correſponded with him therein during their intimacy.

New language invented by Mr Dow.

ALPHÆNIX, white barley-ſugar, to which is given an extraordinary name, to render it more valuable. This ſugar, which is thought good for colds, is made of common ſugar, which is boiled until it becomes eaſy to crack, when they pour it upon a marble table, greaſed with oil of ſweet almonds, and mould it into various figures with a braſs crotchet. It is eaſily falſified with ſtarch.

ALPHERY, Mikipher, an Engliſh divine, was born in Ruſſia, and of the imperial line. When that country was diſtracted by inteſtine commotions, in the latter end of the 16th century, and the royal houſe particularly was ſo ſeverely perſecuted by impoſtors, this gentleman and his two brothers were ſent over to England, and recommended to the care of Mr Joſeph Bidell a Ruſſia merchant. Mr Bidell, when they were of age fit for the univerſity, ſent them to Oxford, where the ſmallpox unhappily prevailing, two of them died of it. We know not whether this ſurviving brother took any degrees or not, but it is very probable he did, ſince he entered into holy orders; and in the year 1618, was preſented to the rectory of Wooley in Huntingdonſhire, a living of no very conſiderable value, being rated under 10l. in the king's books. Here he did his duty with great cheerfulneſs and alacrity; and although he was twice invited back to his native country by ſome who would have ventured their utmoſt to have ſet him on the throne of his anceſtors, he choſe rather to remain with his flock, and to ſerve God in the humble ſtation of a pariſh prieſt. Yet in 1643, he underwent the ſevereſt trials from the rage of the fanatics; who, not ſatisfied with depriving him of his living, inſulted him in the moſt barbarous manner; for, having procured a file of muſqueteers to pull him out of his pulpit, as he was preaching on a Sunday, they turned his wife and ſmall children into the ſtreet, into which alſo they threw his goods. The poor man in this diſtreſs raiſed a tent under ſome trees in the churchyard, over againſt his houſe, where he and his family lived for a week. One day having gotten a few eggs, he picked up ſome rotten wood and dry ſticks, and with theſe made a fire in the church porch, in order to boil them; but ſome of his adverſaries, to ſhow how far they could carry their rage againſt the church (for this poor man was ſo harmleſs they could have none againſt him), came and kicked about his fire, threw down his ſkillet, and broke his eggs. After this, having ſtill a little money, he made a ſmall purchaſe in that neighbourhood, built a houſe, and lived there ſome years. He was encouraged to this by the Preſbyterian miniſter, who came in his room, who honeſtly paid him the fifth part of the annual income of the living, which was the allowance made by parliament to ejected miniſters, treated him with great humanity, and did him all the ſervices in his power. It is a great misfortune that this gentleman's name is not preſerved, his conduct in this reſpect being the more laudable, becauſe it was not a little ſingular. Afterwards, probably on the death or removal of this gentleman, Mr Alphery left Huntingdonſhire, and came and reſided at Hammerſmith till the Reſtoration put him in poſſeſſion of his living again. He returned on this occaſion to Huntingdonſhire, where he did not ſtay long; for being upwards of 80, and withal very infirm, he could not perform the duties of his function. Having, therefore, ſettled a curate, he retired to his eldeſt ſon's houſe at Hammerſmith, where ſoon after he died, much honoured and reſpected, and affording a remarkable inſtance of the viciſſitudes of the world.

ALPHEUS, (Strabo); Alpheius, (Ptolemy); a noted and large river of the Peloponneſus; which, riſing in, and after ſeveral windings running through, Arcadia, and by Olympia in Elis, with a ſouth-weſt courſe, falls into the Sinus Chelonites, about ten miles to the ſouth of Olympia. It has a common ſpring with the Eurotas, at the foot of Mount Parthenius, near the village Aſea, (Strabo.) The Alpheus and Eurotas mix and run together for 20 ſtadia; after which, they enter a ſubterraneous paſſage at Mantinea; then again emerge, the Eurotas in Laconia, and the Alpheus in the territory of Megalopolis, (Pauſanias.) The poets fable ſtrange things of this river, particularly, that out of love to the nymph *Arethuſa*, it runs under the ſea to Sicily, and burſts out at the fountain of that name in Syracuſe, (Virgil.) Its waters were reckoned good in the leproſy, which is called Αλφος by the Greeks; and hence the name *Alpheus*. On the banks of this river the Olympic games were celebrated, to which Pindar alludes.

> " Alpheus, thy immortal flood,
> On his lord's triumphant brows
> The Olympic wreath beſtow'd."
>
> West's Pindar.

Pauſanias adds, that the Eleans had a law, which condemned any woman to death that ſhould either appear at the Olympic games, or even croſs this river during that ſolemnity: and the Eleans add, that the only woman who tranſgreſſed it, had diſguiſed herſelf in the habit of a maſter or keeper of theſe games, and conducted her ſon thither; but when ſhe ſaw him come off victorious, her joy made her forget her diſguiſe, ſo that her ſex was diſcovered. She was pardoned; but from that time a law was made that the keepers ſhould appear there naked.

ALPHONSIN, in *Surgery*, an inſtrument for extracting bullets out of gunſhot wounds. This inſtrument derives its name from the inventor Alphonſus Ferrier, a phyſician of Naples. It conſiſts of three branches, which are cloſed by a ring. When cloſed and introduced into the wound, the operator draws back the ring towards the handle, upon which the branches

Alphonso.

branches opening take hold of the ball; and then the ring is pushed from the haft, by which means the branches grasp the ball so firmly as to extract it from the wound.

ALPHONSO I. king of Portugal, son of Henry of Burgundy, count of Portugal, grandson of Don Alonso king of Leon and Castile, who, as the dowry of his wife Theresa, received part of the kingdom of Portugal. One Egas Munitz had the charge of his education from his father, the duties of which he executed with fidelity and success. In the year 1112 his father died, leaving him a boy only three years of age, when the reins of government and the care of the infant son fell to his mother Theresa. At the age of 18 he assumed the sovereign authority by the advice of the nobles of Portugal, who were highly offended at the growing partiality of his mother for Don Ferdinand Perez, count of Trastemara; for it was suspected that she intended to marry him. But Theresa was little disposed to resign the reins of government. Her party raised an army which took the field to oppose the nobility who supported Alphonso; but her adherents were defeated, herself taken prisoner, and kept in confinement during the remainder of her life. Not long after his accession to the throne, his abilities both to govern and to conquer received a severe trial, in several arduous enterprises, as well against the king of Leon and Castile as against the Moorish princes, who then possessed great part of Spain and Portugal. The Moorish emperor in Barbary having sent a strong reinforcement to the princes, they were enabled to take the field with an army far superior to that of Alphonso's; yet he valiantly met them in the plains of Ourique, and totally defeated their forces. Thus Providence conferred such a signal favour on the Christian arms as procured a residence for Christianity in those parts. The ambitious king of Leon and Castile assumed the title of emperor of the Spaniards, and entered Portugal to waste and destroy; but after the emperor had received a temporary check, the matter was accommodated, and he withdrew his army. In consequence of the victory obtained on the plains of Ourique, Alphonso was instantly proclaimed king; but the form and constitution of the monarchy was not settled until the nobility, prelates, and commons had assembled at Lamago for that purpose in the year 1145. The conquest of Santaren preceded this event, and was sanctioned by the unanimous concurrence of the states. The honour of crowning the king was conferred upon the archbishop of Braga; and it was legally provided, that the regal succession should descend with an uninterrupted succession to the heirs male of Alphonso. The prelates and nobility, with the concurrence of the people, instituted a code of laws consisting of 18 statutes, for the government of the kingdom. It being proposed whether it was their pleasure that the king should go to Leon and do homage to that prince or to any other, every man drawing his sword, exclaimed, "We are free, and our king is free, and we owe our liberty to our courage; and if he shall at any time submit to such an act, he deserves death, and shall not either reign over us or among us." The year after his coronation he was married to Matilda, daughter of Amadeus, count of Maurienne and Savoy; and he recovered Lisbon from the hands of the Moors, in the year 1147. A multitude of adventurers being assembled at the mouth of the Tagus in their progress to the Holy Land, greatly assisted him in this conquest. After having added six other provinces to his dominions, he wisely began with industrious activity to regulate the affairs of his kingdom. In all his great and benevolent designs he was vigorously seconded by Matilda, a princess equally celebrated for her great beauty, mental vigour, and singular piety. With the prudence of the statesman, and the benevolence of the man, he laboured as much for the population of his acquired territories as for their increase. The conjugal felicity of this prince and princess was greatly enhanced by a numerous offspring, which enabled him, by great alliances, to strengthen his interests. His second daughter was married to Don Ferdinand, king of Leon, who, notwithstanding of this alliance, ungenerously made war on his father-in-law, and took him prisoner in the field of battle; but released him, on the humiliating condition of coming in person to do homage for his dominions at Leon. In the latter part of his reign, his son Don Sancho, who inherited all his father's military talents, took the lead on several occasions; and in the year 1180, Joseph, king of Morocco, and emperor of the Almohedes, advanced with an army as far as Santaren, and there gained a glorious victory over him. Such was the consternation of the infidels, in consequence of this defeat, that they left the Portuguese at liberty to improve the interior part of the country, and to fortify their frontiers during the whole of the next year. Worn out with care and intense application, Alphonso needed repose, and had retired to Coimbra, where, after a reign of 57 years, and in the 76th year of his age, he died. In the church of the holy cross at Coimbra his remains were deposited with great funeral solemnity. He was no less than seven feet high; and his gigantic size and his martial ardour have given occasion to many absurd and incredible stories concerning his military achievements, so that, in the annals of chivalry, as well as in the records of martial exertions, he sustains a very high rank. Two orders of knighthood, that of the Wings, and that of the Avis, were instituted by him; and they still continue to flourish in that kingdom. At the age of 31, when all the faculties of the human mind are in full vigour, Don Sancho, his son, succeeded him. (*Mod. Univ. Hist.*)

ALPHONSO II. distinguished by the surname of the *Fat*, was the third king of Portugal, and succeeded his father at the age of 27 years, in 1212. His accomplished education and his military and political talents were tarnished by his great neglect and hatred of his brothers and sisters, which involved him in many troubles. He, however, commenced his reign with two very popular actions. The one was, sending a body of infantry to the assistance of the king of Castile, who fought with uncommon bravery in the renowned battle of Navas de Tolosa. The other was, his donation of the Castle of Avis to the knights of that order, when the grand-master removed from Evora, and took up his habitation in that castle. During the life of his father, he discovered his aversion to the rest of the family, which induced him to secure the right of his children from the effects of his resentment

Alphonso. as much as in his power, by conferring upon them large sums of money and jewels, and some of the best parts of the kingdom. After the death of his father, however, Alphonso strenuously laboured to convince them that it was not in the power of his father to separate or give away any part of his dominions; but all his urgent eloquence proving unsuccessful, he had recourse to arms. The two princesses, his sisters, who had received by the grant of their father very extensive and valuable property, upon being attacked by their brother, implored the interference of the pope, and also applied to the king of Leon, to grant his protection, so that they made a very vigorous defence. The pope granted the request of the young princesses, and threatened to excommunicate Alphonso; and from Galicia, Don Ferdinand entered the dominions of Portugal to ravage and destroy; but the king prepared to defend himself against the arms of the king of Leon, and by specious pretences to evade the excommunication of the pope.

Authors are not agreed with respect to the success of this war, but it is generally supposed that, by the interference of these two powerful persons, the domestic affairs of that house were restored to a certain degree of tranquillity; however, the departure of the infant Don Ferdinand to the court of Castile, and of Don Pedro to another place, strongly indicate that the reconciliation was far from being perfect. The conduct of the king, however, produced much diversity of opinion among the common people of Portugal. Some were induced, by the arguments of the king, to conclude that it was not in the power of Don Sancho, the late king, to dismember his kingdom; and others very properly suspected the kindness of a prince to his people who displayed such uncommon and such unjustifiable hatred to his own relations; at the same time, those nobles whom the father had solemnly sworn to carry his will into execution, regarded the sacred nature of their oaths to such a degree as induced them to operate against the reigning prince.

The displeasure of the pope, however, was not to be endured. The mind of Alphonso seemed indeed to be of that quality which little regarded the displeasure or thunders of his holiness; but the effects of his threatenings were very different upon the public mind, consequently the king was constrained to seek the favour of the pope, to retain the obedience of his subjects. The king therefore sent deputies to Rome, who argued, that the crown his father wore was the purchase of the blood and valour of the Portuguese nation, and therefore not in his power to alienate; that it was a dangerous precedent, and obviously tended to subvert the sovereignty of a state; that the disuniting of the kingdom would tend to promote the cause of the infidels; and, in fine, that his disputes with his sisters had no connexion with ecclesiastical matters. The pope, however, was as well qualified to discern the nature of these specious arguments as the prince was qualified to urge them, consequently he remained unmoved; and Alphonso, in order to have the sentence of excommunication removed which had been pronounced upon him, was reluctantly induced to be reconciled to his sisters. His holiness informed of the reconciliation, with great ceremony revoked his curse and excommunication from the king and his subjects.

But the reign of this prince was destined to troubles; Alphonso. for no sooner was this domestic broil terminated, than the Moors rushed into the plain country in such prodigious numbers, that the king found it very difficult to repel them, or to drive them back to their own country. A favourable occurrence, however, enabled him to complete his object, by the taking of a fortress seated on a rock which was deemed impregnable, in the following manner. The Germans and Flemings had equipped an immense fleet destined for the Holy Land, consisting of 300 sail, with a numerous army on board. In consequence of tempestuous weather, their fleet was so disabled that they were forced to put into the harbour of Lisbon to refit, just at the time when Alphonso was preparing an army to attack the Moors. The king instantly sent some of the most respectable men of his court to solicit their aid against the Moors, alleging that it was perfectly consistent with their vows to fight against the Moors in Portugal, as well as in the Holy Land. William earl of Holland, and many other generals, were convinced by this argument, and cheerfully engaged to join him against the infidels; but about a third part of the fleet refused to join, and proceeded on their voyage. It happened, however, that they were driven by a violent storm into Italy, where they wintered. The greater part of the nobility and gentry landed under the conduct of William earl of Holland; and it was resolved that they should proceed by sea, and block up Alcaçar-do-Sal, the fortress already mentioned, while the army of Alphonso, reinforced by a considerable number, should march by land; and thus attack the place both by land and sea at once. The Moors, convinced of the importance of this place, brought an army into the field consisting of 50,000 men; but the Christians raised the siege, gave them battle, and routed them with great slaughter; and some of the chiefs of the Moors fell in the field. The fortress surrendered on the 21st of October 1217, and was conferred upon the order of St James; but notwithstanding of very urgent entreaties, the pope would not permit the army to winter in Portugal. He was desirous of having these troops and their generals removed to a greater distance. The writers of that nation affirm that the soldiers experienced supernatural aid in this battle, and that the banner of the cross was actually displayed by angels.

But civil animosity succeeded to infidel war. The archbishop of Braga was highly offended that the clergy were forced to pay money and furnish troops to carry on the war against the infidels; and the people severely complained of the strictness of the laws. To chastise the rebellious clergy, the king seized upon the revenues of the bishop, and forced him to fly from his dominions. Enraged at this impious conduct, the pope excommunicated the king, and laid his kingdom under an interdict. The natural consequence was, that all things were thrown into confusion and consternation, and perplexity universally prevailed; so that Alphonso was obliged to consult measures to quell the rising discontent. It happened, however, that in the midst of these negociations he was removed by death, and not only died under the papal malediction, but left his kingdom under the same curse. He was interred without royal honours in the conventual church

Alphonso. church of Alcobaça. His perſon was above the common ſize; he was brave and ſtrong, but not devoid of many qualities worthy of blame. (*Mod. Univ. Hiſt.*)

Alphonso III. *Don*, king of Portugal, ſucceeded his brother Don Sancho II. in the year 1248. In the courſe of a war with the Moors, which he engaged in at the beginning of his reign, he conſiderably extended the Portugueſe dominions. He took poſſeſſion of the city of Fara, the capital of the Mooriſh kingdom, in the province of Algarve. Loula, another Mooriſh town, which was carried by ſtorm, alſo fell into his hands. His power was thus extended abroad by the ſucceſs of his arms, and the adminiſtration of his affairs at home became proſperous and popular by his wiſdom and prudence. But the tranquillity and proſperity of the kingdom were ſomewhat diſturbed by an interdict which it was put under by Pope Alexander IV. whoſe diſpleaſure he had incurred by marrying Donna Beatrix, the natural daughter of Don Alonſo the Wiſe, king of Caſtile, while his firſt wife was living. In 1262, when his firſt queen died, the interdict was removed by Pope Urban, a diſpenſation was granted, and the children of Donna Beatrix were legitimated. Hitherto frequent diſputes had occurred between the kings of Portugal and Caſtile relating to the boundaries of the two kingdoms. To terminate all differences on this ſubject, and to prevent them in future, commiſſioners were appointed to define and ſettle the limits of their reſpective dominions; and theſe were agreed to and acknowledged by a ſolemn deed.

Encouraged by the proſperity of his kingdom, and by the ſucceſs which had attended his enterpriſes, Alphonſo made an attempt to extend the influence of the crown, by obliging the clergy to contribute to the welfare of the ſtate. But this meaſure, as might have been expected, was not quietly ſubmitted to. It occaſioned the revival of old diſputes, the pope interfered, and in 1268 the kingdom was again laid under an interdict. He ſucceeded, by the wiſdom of his negotiations, in obtaining from Caſtile an exemption of all claims upon the crown of Portugal, and in procuring an acknowledgment that its monarchs were entirely relieved from the performance of every kind of homage. He died in the year 1279, in the 69th year of his age, and in the 31ſt of his reign. Before his death, he was reconciled to the pope and clergy, having made a full and ample ſubmiſſion. This prince was tall in ſtature, of a prepoſſeſſing aſpect, and of engaging manners. Alike removed from a diſpoſition to extravagant expence or ſordid avarice, in times of peace and proſperity, he could indulge in magnificence; but when his affairs required it, he failed not to regulate them by frugality and economy. To the poor he was a ſincere friend. In a time of ſcarcity, he pawned his crown to provide them with bread. His ſteady and vigorous adminiſtration ſecured to him the reſpect of the nobles and the obedience of the clergy. (*Mod. Univ. Hiſt.*)

Alphonso IV. king of Portugal, ſurnamed the *Brave*, was the ſon of King Denis. Inſtigated, it is ſaid, by the queen dowager of Caſtile, and moved with jealouſy againſt his natural brother Alphonſo Sanchez, he revolted againſt his father, and commenced a civil war. In this unnatural and baſe war, he was juſtly unſucceſsful; but although he was reduced to ſubjection, yet his haughty and ungovernable temper broke out in many occurrences, until he ſucceeded his father in 1324. Hunting was his favourite amuſement at the time when he aſcended the throne; and one day entertaining his counſellors with a narrative of his ſporting adventures during a month, one of them ventured to remonſtrate againſt his conduct, and even proceeded to threaten, that if the grievances of his ſubjects were not ſpeedily redreſſed, they would be forced to look out for a better king. Alphonſo was greatly enraged; but ſuddenly recollecting himſelf, he ſaid, "I perceive the truth of your remark; he cannot long have ſubjects who will not be a king. Remember that from this day, you have nothing to do with Alphonſo the ſportſman, but with Alphonſo the king of Portugal." To this reſolution he ſtrictly adhered, and exerciſing the power of a deſpot, he overawed his ſubjects, without conciliating their favour or procuring their eſteem. He diſplayed a conduct very ſingular in a young man, regarding thoſe who had ſo vigorouſly oppoſed him when at war with his father, as friends to the crown, although enemies to the young ambitious prince. He commenced his reign with deviſing plans for the ſecurity of his family in the government, and the good of the kingdom; he likewiſe manifeſted a ſtrong benevolence of heart, in his affection for his conſort queen Beatrix, and his dutiful conduct towards his mother. Notwithſtanding all theſe amiable qualities, he perſecuted his brother Alonzo Sanchez, and wiſhed to inflict the puniſhment due to him as a proſcribed traitor; which drove the deſperate Alonzo to open rebellion. But, however, the natural good qualities of the heart of the king roſe ſuperior; ſo that his perſecuted brother was again received into favour. Not long after he engaged in war with Alonzo XI. king of Caſtile, and which, after ſeveral ſevere ſtruggles with varying ſucceſs on both ſides, terminated in an alliance, and in effectual aſſiſtance againſt the Moors. The artful and cruel part which he acted towards Donna Agnes de Caſtro, the miſtreſs and concealed wife of his ſon, reflected the greateſt diſgrace upon his character. It is proper, however, to remark, that he was inſtigated to the murder of this princeſs by his courtiers. It was not therefore to be wondered at if his ſon was induced by this act to riſe up in open rebellion againſt him, but the arms of his father were too formidable; and after his ſubmiſſion, his father treated him with particular marks of attention. Inſtructed by the growing infirmities of years, he ſaw the termination of his reign and his life approaching. He began to compenſate for his paſt errors and faults, by eſtabliſhing acts of piety and benevolence, by redreſſing grievances, by reſtraining immorality through the eſtabliſhment of pious laws, by dictating ſalutary maxims for the government of the ſtate, by removing thoſe from the ſeats of power, who were the moſt likely to become the objects of reſentment after his death: he thus laboured to efface from the remembrance of his ſon the inſult which he had received. While concerting theſe conciliating meaſures, he died in May 1357, in the 32d year of his reign, and the 67th of his age, "with the character of an undutiful ſon, an unnatural brother, and a cruel father." But in many reſpects he deſerves the character "of a great man and a great king, brave and fortunate in war, but artful and indirect in his political meaſures, attached to his ſubjects, Alphonfo. fubjects, ftrict in the adminiftration of juftice, attentive to the public welfare, and affiduous in encouraging induftry, and enriching his people." But after all, it muft be acknowledged, that although he was feared and even efteemed, he was not much honoured nor beloved, but was rather reverenced for a proper ufe of power, than relied upon as a public parent. His character is perhaps expreffed in his device, which was an eagle on the wing, with the following motto, *altiora peto*, " I aim at higher things."

Alphonso V. *Don*, king of Portugal, was born in 1432, and on account of his heroic deeds, obtained the furname of the *African*. At the age of fix years, he fucceeded his father King Edward. The adminiftration of the affairs of the kingdom during his minority, was entrufted to his uncle Don Pedro, who, although his public conduct met with general approbation, was perfecuted as a traitor at the expiration of his regency, and with feveral perfons who were attached to his intereft, and involved in his misfortunes, was put to death. The young king had married the daughter of the regent; but even his influence, which was overpowered by the regent's enemies, could not fave him from perfecution. Afterwards indeed he did juftice to his memory, and difcovered an unufual mark of refpect and attachment to his queen, by abftaining from all connexion with the fex after her death, which happened in 1455, and it has been fuppofed, was occafioned by poifon, adminiftered by the enemies of her father.

Alphonfo afpired to the acquifition of military glory. In the year 1458, he made great preparations to attack the Moors in Barbary. He affembled an army of 20,000 men, and equipped a fleet of 200 fail. He firft directed his arms againft Alcazer, which foon fell into his hands; and to maintain the footing which he had gained, he furnifhed this place with a ftrong garrifon. For 12 years he profecuted the war in Barbary with various fuccefs, in that time reduced Arzila and Tangier, and in 1740, returned to Portugal loaded with honours. It was then he obtained the furname of *African*, and to the titles which he derived from his anceftors, added that of *lord of the coafts on both feas*. And with a view to perpetuate the memory of thefe exploits and conquefts, he caufed a reprefentation of them to be wrought in tapeftry, a monument furely conftructed of very frail materials, but not lefs durable than many which have been erected by ambition and vanity. During the war in Africa, a military order denominated *the knights of the fword* was founded.

Alphonfo was lefs fuccefsful in fupporting the claim of his niece Donna Joanna to the crown of Caftile againft Ferdinand and Ifabella. Finding his own refources unequal to the conteft in which he was engaged, he took a journey to France to folicit the aid of Lewis XI. But his folicitations proved fruitlefs; and the mortification which he experienced from this faithlefs monarch, filled him with melancholy, and induced him to refign his crown for the purpofe of making a pilgrimage to the Holy Land. The adminiftration of affairs during his abfence, was committed to the hands of his fon Don Juan, who governed the kingdom with great ability. When the king returned, he was joyfully received by the prince, and reinftated in his authority. But the mind of Alphonfo had loft its wonted vigour, and was unfit to refume the arduous duties of government. Oppreffed ftill with a deep melancholy, he determined at length to withdraw from the cares of a kingdom, and to end his days in the repofe and quiet of a monaftery. But on his journey to the place of his retirement, he was feized with the plague at Cintra, where he died in the year 1481, in the 43d year of his reign, and the 49th of his age. The moderation, the wifdom and prudence which this prince exhibited in his public conduct, were not more powerful in conciliating the love and veneration of his fubjects, and of all good men, than were the amiable virtues of his private character. He was diftinguifhed for his affability and condefcenfion, his benignity and bounty, and efpecially for his unbounded charity. In the exercife of this latter virtue, he was honoured with the title of *redeemer of the captives*, in confequence of his having procured the freedom of many prifoners, whofe ranfom he cheerfully paid. Nor was he lefs eminent for his chaftity and temperance, his attachment to letters, and his love and encouragement of learning. The firft library in the palace of the kings of Portugal was founded in his time. He eftablifhed and vindicated againft the pretenfions and hoftile attempts of the Spaniards, a very profitable trade on the coaft of Guinea, which country was difcovered during his reign, under the aufpices of his uncle Don Henry, a celebrated character of that age. (*Mod. Univ. Hift.*)

Alphonso VI. *Don Enriquez*, king of Portugal, afcended the throne when only a child of thirteen years of age. It is not eafy to conceive a kingdom in a more perilous fituation than this at the death of Don John. The young king was remarkable for weaknefs of body, and imbecility of mind; the regency in the hands of a woman, and that woman a Caftilian; the nation involved in war, and this refpecting the title to the crown; many of the nobility engaged in feuds and contentions with each other, and fome of them fecretly difaffected to the reigning family; fo that the queen fcarcely knew to whom fhe could truft, or by whom fhe was to be obeyed. A very indecent joy was manifefted by the people on the king's death, as if his death was the diffolution of government: but the great abilities of the queen, and the vigorous meafures which fhe adopted, foon changed the face of affairs. For her own fafety, and the profperity of the kingdom, fhe appointed Don Francifco de Faro, count of Odemira, of the houfe of Braganza, governor to the king, and one of her principal minifters of ftate; and fhe made choice of Don Antonio de Menefes, count de Caftenheda, to be his coadjutor. The former was a perfon in high repute among the nobility, in great favour with the people, entirely devoted to the interefts of the queen, poffeffed of a large eftate, and far advanced in years; the latter was alfo an aged man of great talents, and equally capable to prefide in the cabinet, and to command in the field. As might naturally be expected, thefe men fometimes differed in opinion; but this difference never hurt the caufe of the queen. Seconded, protected, and counfelled by fuch able men, the nation began to feel the effects of the queen's firmnefs and fuperior talents.

The firft important exertion of the queen was, to fend

Alphonso. send express orders to the count de San Lorenzo, who commanded on the frontiers, to act offensively; but the measure, though prudent in itself, was not attended with the desired success. About this time, however, the duke de St Germain, an Italian officer in the service of Spain, entered Portugal, besieged and took Olivenza and the castle of Moran. In consequence of this, the general was dismissed, and his place was filled by Juan Mendez Vasconcelles, a man in great favour with the troops, and universally popular. He engaged to act also upon the offensive, but being unsuccessful, he was only saved from punishment, by his simple and candid defence; in which he says, "that he had undertaken the siege in obedience to the order of the queen, and for the honour of the nation; and that he had raised it without orders, for the preservation of the army: that he knew the hazard he run when he did it, but that it gave him pleasure to think, that at the hazard, or even the loss, of his reputation and life, the troops of Portugal had been saved." He was declared innocent and worthy of the queen's favour, by the council of war who presided. Don Sancho Manuel, who commanded in Elvas, and defended it with equal bravery and conduct, shewed himself to be an officer of a considerable degree of judgment, by his hazarding nothing more when he had performed his service, upon which the very being of the state depended; but it was the count de Castanheda who raised that siege, and forced the army of Spain in their lines. After some other political measures, some of them more, and some of them less important; the queen regent finished in a manner, her administration, with the marriage of her only daughter, the princess Catharine, once intended for Lewis XIV. with Charles II. king of Great Britain, one of the most fortunate events that ever happened for Portugal; since it immediately procured them the protection of the English fleets, reinforcements of some thousands of horse and foot; besides adding much reputation to their affairs throughout Europe; which was the reason that the Spanish court opposed it with so much heat, or rather, passion. By the vigorous exertions and fortunate victories of Montesclaros, the war was soon terminated to the honour of Portugal. The sixth and last victory in the course of 28 years, was obtained by the Marquis de Marialva, which was chiefly owing to unforeseen accidents, and the determined courage of foreign troops, and to the great abilities of Schomberg. This victory determined the fate of the kingdom, though not of the sovereign; and it was easy to be seen by the more intelligent sort of people in Portugal, that the king would sooner or later be deposed.

Alphonso being struck with the palsy while a child, rendered it necessary to treat him with indulgence, on account of his weak state of health; consequently, as he rose to maturity, his want of parts, and the defects in his education, were very perceptible. It is alleged that a greater affection was shewn by the queen his mother, to the infant Don Pedro, and that she endeavoured at the time of their father's decease, to insinuate into the nobles an idea of preferring him; but they universally declined to make a breach in the succession, declaring it was difficult to make an estimate of the powers of a king who was then only a child. The queen yielded, and endeavoured by every proper means to make him worthy of a crown, which, by birth, he was entitled to wear. The count de Odemira, who was charged with his education, found it a very difficult task to manage the young prince, who, forgetful of his birth and destination, was prone only to those amusements which the youth of his age were accustomed to. His guardian and preceptor struggled with this disposition, and even ventured to take some pretty severe measures; but to his great mortification, it proved entirely abortive. Education can only improve, but can never confer mental abilities. Yet he was quick enough to perceive he was a king, which proved very fatal to him. Those who approached his person complied with his follies, and, even commended the most absurd actions; and those who were independent of the court inveighed against him in the strongest terms, and, because guilty of some childish actions, they ascribed to him all the cruel and foolish accidents which happened in Lisbon. Unfortunately, however, for his adversaries, many of these actions, such as fighting of dogs, scouring the streets, encountering three men alone, running at a bull, and such like, indicate no want of strength or courage. A variety of facts that might be mentioned, are sufficient evidence that his natural dispositions were weak, wild, refractory, and unteachable; and that although he was born to reign, yet he was destitute of the qualities absolutely necessary in a prince. The direful consequences of this having been for some time experienced by the nation, the nobles at last were driven to the resolution of deposing the king, and exalting Don Pedro to the regency. In the morning of the next day after the determination, the marquis de Cascaes, at the head of the council, went to the palace to propose the resignation to the king. The king was in bed and fast asleep: the marquis ordered him to be awakened, and knocked violently at the door for that purpose; and when he had obtained admission, he is said to have upbraided him in very coarse terms for his laziness and inattention to public affairs at so critical a conjuncture; adding, that since he must be sensible of his want of abilities to govern a kingdom, the wisest method he could adopt was, to resign it in favour of his brother. The king absolutely refused to consent, but not long after, Don Pedro coming to the palace, ordered him to be confined in his apartment, where one of his favourites persuaded him, in the hope of being set at liberty, to make a short renunciation of the crown in favour of his brother Don Pedro, and his lawful issue, reserving the house of Braganza and its dependencies, together with 100,000 crowns out of the revenue of the crown. Nor was this deemed sufficient: for a paper was presented to him, making him avow, that for want of consummation, his marriage was null. This he at first declined; but, by the advice of some divines, he was prevailed on to subscribe the deed. When evening drew on, the unhappy king then perceived he was a prisoner; upon which he sent to request his brother to let him have John, who managed his dog-kennel, to keep him company. When Don Pedro heard it, losing his usual calmness, he burst into a violent fit of passion, and instantly gave orders, that those who were the most agreeable to him, should remain in his apartment. Such was the situation of affairs until the meeting of the states. But in in the mean time, the unfortunate Don Alonzo died, after he had been a priſoner near fifteen years, ſuddenly in the caſtle of Cintra, on the 12th of September, when he had borne the title of king almoſt twenty-ſeven, and had lived about forty, years. It is reported, that he ſaid in his laſt agonies, "I am now going; but it will not be long before the queen ſhall follow me, to give an account, at the moſt awful tribunal, of the wrongs ſhe has done me." (*Mod. Univ. Hiſt.*)

Alphonso III. the Great, king of Aſturias, was born in 847, and ſucceeded his father Ordogno in 865. In conſequence of the rebellion of Don Frolia, not long after his acceſſion to the throne, he was forced to leave his kingdom; but that uſurper being aſſaſſinated, with univerſal applauſe he returned to his throne. In many ſucceſsful enterpriſes againſt the Moors, in which he greatly enlarged his territories, he ſoon diſplayed the talents of a warlike and able prince. He formed a powerful alliance againſt the Moors, by marrying Ximene or Chimene, deſcended from the houſe of Navarre, which paved the way for a long ſeries of victories. The great attention which he paid to the comfort and welfare of the common people, greatly diſguſted his haughty nobles; which excited them to revolt againſt him in the advanced part of his life. Enjoying a ſmall interval of tranquillity from the diſtraction and tumults of war, he called a general council of the clergy and nobility, enacted ſome uſeful regulations, and directed their attention to ſeveral other ſubjects, which contributed to the honour and happineſs of his kingdom. Whilſt he was buſily occupied in repairing ſome of thoſe towns which he had taken from the Moors, he was ſuddenly interrupted by them, and was under the neceſſity of defending himſelf with a conſiderable army, which he did with ſuch ſucceſs, that they were defeated with great loſs. The unnatural rebellion of his ſon Don Garcias, at this time, greatly diſturbed his government; but by the diligence of the father, this unnatural rebellion was ſoon quelled. The confinement of Garcias, and the new impoſition of taxes, produced general murmurs among the people; which induced Alphonſo, now worn out with years and inceſſant contentions, to aſſemble the ſtates, and reſign the reins of government into the hands of his ſon Don Garcias. He gave to his other ſon Don Ordogno the province of Galicia. The ambitious and military ſpirit which Don Garcias diſcovered in his father's reign, ſoon diſplayed itſelf in an attack on the Moors. By the advice of his father, to which he prudently liſtened, he was taught that theſe new conqueſts tended more to enrich the ſoldiers, than to the advantage of the crown. Alphonſo, although far advanced in years, took upon himſelf the command of the army raiſed for new operations, and returned to Zamora loaded with ſpoils, and with increaſed reputation and fame, in the year 912. He died December 20th, 912, two years after his abdication, 49 years from the time of his being aſſociated with his father in the government, and when he was about 63 or 65 years of age. His great learning, and the patronage he gave to literature, his diſtinguiſhed piety and virtue, and other princely qualities, raiſed this king high in the eſtimation of mankind. Some writers affirm that he compoſed a chronicle of the Spaniſh affairs, from the death of Receſuintho, to that of his own father Don Ordogno, which has been incorrectly publiſhed by Sandovel, and the later editions has ſuſtained conſiderable injury. The biſhop of Orenſa, at whoſe requeſt it was originally compoſed, publiſhed it in his own name to the world. (*Gen. Biog.*)

Alphonso X the Wiſe, king of Leon and Caſtile, ſucceeded his father Ferdinand in the year 1252. He obtained the appellation of wiſe, not for his political knowledge as a king, but his erudition as a philoſopher. In conſequence of the general opinion of his princely qualities, and his uncommon generoſity, he aſcended the throne with univerſal approbation. The ill-concerted projects of his ambition, however, diſturbed the proſperity of his reign. Pretending a better right than Henry III of England to that territory, he directed his firſt attempt againſt Gaſcony. The arms of England, however, proved too formidable; and he was compelled to renounce his claim, on condition that Henry's ſon, afterwards King Edward I. ſhould marry his ſiſter Eleonora. At an expence which drained his treaſures, and obliged him to debaſe his coin, he prepared for an expedition againſt the Moors in Barbary; but his maternal right to the duchy of Swabia, which he was called to defend, diverted him from it. Thus he formed a connexion with the German princes; and became a competitor, with Richard earl of Cornwall, for the imperial crown, in queſt of which they both expended immenſe ſums of money. The claims of ſeveral of the princes of the blood, gave exerciſe to his military talents; and he was ſucceſsful both in oppoſing and defeating them. He formed the romantic deſign of viſiting Italy in the year 1268; but the ſtates firmly remonſtrating, he was obliged to relinquiſh it. But, although he abandoned the deſign, yet it produced ſuch diſcontents both among the common people and conſpiracy among the nobles, that it required conſiderable exertion before the king could allay the ferment. Alphonſo, ſtill anxious of aſcending the imperial throne, attempted it after the death of Richard earl of Cornwall, and even after Rodolph of Hapſburg was actually elected emperor of Germany, and for that purpoſe took a journey to Beaucaire to obtain an interview with the pope, in order to prevent him from confirming the election. The Moors, ever ready to draw the ſword againſt him, took this opportunity of entering his dominions for the purpoſe of ravaging them. This ambitious journey, undertaken at ſo vaſt an expence, and productive of ſo much confuſion in his kingdom, proved unſucceſsful; for the pope would not realize his claim, or alter the former election. But his exceſſive ambition was ſoon puniſhed by domeſtic calamity; for his eldeſt ſon died in this interval, and his ſecond ſon Don Sanchez, having obtained great reputation in oppoſing the infidels, to the prejudice of his brother's children, laid claim to the crown. This claim was admitted by the ſtates of the kingdom; but Philip king of France, ſupporting the cauſe of the children, whoſe mother was his ſiſter Blanche of France, involved Alphonſo in a war; and it occaſioned the retreat of his own queen Yolande or Violante to the court of her father, the king of Arragon. While thus haraſſed with diſſenſions, he proclaimed war againſt France, and by the authority of the pope he renewed the war with the Moors, which proved ſo unfortunate, that he reluctantly concluded a truce with them, and engaged in a conteſt with

Alphonso. with the king of Granada. These various measures exhausted his treasure, taxes were multiplied, and the affairs of the kingdom were in such confusion, that he was under the disagreeable necessity of calling an assembly of the states, which was held at Seville in the year 1281, where, on the king's proposal, the states consented to give a currency to copper money. In consequence of the intrigues of Don Sanchez his son, another assembly of the states was held at Valladolid A. D. 1282, which deprived Alphonso of the regal dignity, and appointed Sanchez regent. Reduced to almost insurmountable difficulties, Alphonso solemnly cursed and disinherited his son, and by his last will, in the year 1283, confirmed the act of exclusion, and appointed, for the succession, the infants de la Cerda, and upon the failure of their heirs the kings of France; and at the same time supplicated the assistance of the king of Morocco against the power of his son. At the commencement of the next year, when Alphonso received information, from Salamanca, that Sanchez was dangerously ill, his heart relented. He pardoned his son, revoked his curses, and then died on the 4th of April 1284 in the 81st year of his age. His remains were interred in the cathedral of Seville; and he left behind him the character of a learned man, but a weak king. Alphonso has been charged with irreligion and impiety, chiefly on account of a well known saying of his, *viz.* "if he had been of God's privy-council when he created the world he could have advised him better." The various contradictory accounts, given by different writers render the truth of this doubtful; but if ever such a horrible saying dropt from his lips, it must unquestionably be declared inconsistent with the character of an enlightened philosopher; and that reverence of the Creator, which an enlarged contemplation of his works naturally inspires.

"An indevout astronomer is mad." Young.

He was an eminent proficient in science, and a patron of literature. He concluded that book of laws, known by the title of *Las Partides*, which his father had begun; and in that work displayed the abilities of a politician as well as those of a legislator. By obliging his subjects to use their own language, he redressed the confusion in law proceedings occasioned by intermixing Latin with the vulgar tongue. Under his patronage a general history of Spain was composed, which he took great pains in polishing; he also corrected many errors in the statutes of the university of Salamanca. Astronomy being his favourite study, he chiefly directed his attention to the improvement of that science; so that, even during the life of his father, he assembled at Toledo a number of the most celebrated astronomers of his time, Christians, Jews, and Arabians, from all parts of Europe, for the purpose of examining the astronomical tables of Ptolemy, and correcting their errors. The completion of these tables employed them about four years, and in 1252, the first year of Alphonso's reign, they were completed; and they were called *Alphonsine Tables* from the name of this prince, who encouraged the construction of them by his unbounded liberality. It is reported that 400,000 ducats were expended on them, or, according to others, 40,000. Some have ascribed the principal management of this work to the Jewish Rabbi Isaac Aben-Said; others, pretending to derive information from the MSS. of Alphonso, refer it to Aben-Ragee and Alcabitius. The other astronomers who were employed on this occasion were Aben-Musa Mohamed, Joseph Ben-Ali, and Jacob Abuena, Arabians: if there were any Christians, their names are unknown. The 30th of May 1252, which was the day of his accession to the throne, was fixed as the epoch of these tables. A book, entited "The Treasure," is also ascribed to him, containing treatises of rational philosophy, physics, and ethics. He is likewise said to have been well acquainted with astrology and chemistry; in which last science, he is said to have compiled two volumes in cipher, which are extant, and to be found still in his Catholic Majesty's library. But this work must be more curious than useful, if we consider the state of this science at that period. (*Gen. Biog.*)

Alphonso. Alphonso V. king of Arragon and Naples, succeeded his father in the year 1416. As the father had formerly been honoured with the appellation of *Just*, so the son was honoured with that of *Magnanimous.* The conspiracy of some of his own nobles against his life, together with the insolence of Pope Benedict XIII. greatly disturbed the tranquillity of his reign. Fortunately this conspiracy was discovered just when it was about to be carried into execution; and instead of proceeding with rigour against the conspirators, he generously tore a paper containing their names without reading it, and added, "that he would at least force them to acknowledge, that he had a greater regard for their lives than they had for his." After quelling a disturbance in Sardinia, he was just making preparations to advance to Sicily, when Joan of Naples offered, if he would assist her against the pope, the duke of Anjou, and the constable Sforza, who had formed a confederacy to depose her, to adopt him as her son and heir. He readily accepted the proposal, and with a powerful army soon raised the siege of Naples, and was immediately declared heir apparent of her kingdom, and duke of Calabria. But as the queen was unfaithful, and did not fulfil her engagements, Alphonso took possession of Naples, and expelled her from it; but when the duke of Anjou again entered her territories, and made himself master of great part of them, she was obliged to renew her solicitations to Alphonso; who, in the year 1434, involved himself in a quarrel with the duke of Milan and the republic of Genoa, by besieging Gæta in a second attempt to conquer Naples. The Genoese fleet engaged Alphonso; and all his ships were dispersed or destroyed, and himself taken prisoner. But such was the address of this prince, that when carried to Milan a prisoner, he there ingratiated himself so much into the duke's favour, that he became his friend and ally, and soon rose to greater power than formerly.

He got possession of Naples in 1443; and in an assembly of the states held at Beneventum, and then transferred to Naples, his sovereignty was recognized, and his son, Don Ferdinand, declared successor to the throne, and in consequence of this elevation he was deemed the sole arbiter of peace and war through all Italy. Naples became the residence of Alphonso during the remainder of his life; but his declining years were much disquieted by political dissensions and intrigues. The natural attendant of jealous old age at last

Alphonso. Alphonsus. last seized him; and in consternation and dread, he was removed from one castle of Naples to another, until he breathed his last on the 22d of June 1468, bequeathing to his natural son Ferdinand the kingdom of Naples, and to his brother Don Juan, king of Navarre, the kingdoms of Arragon, Valencia, Majorca, Sardinia, Sicily, and the principality and dependencies of Catalonia. Alphonso was not only deemed the ablest statesman, and the most renowned military commander in that age, but also the greatest prince that ever occupied the throne of Arragon. He was a distinguished patron of learning, and opened an asylum for the Greek literati expelled from Constantinople. His device was an open book. He frequently uttered this expression, "That an unlettered prince was but a crowned ass." He was brave and liberal; and in all his negotiations he disdained the mean artifices of intrigue and dissimulation. It is reported that his perusal of Quintus Curtius cured him of a disorder with which he was attacked at Capua. Such was his familiar intercourse with his subjects, and his affection towards them, that he walked unarmed and unaccompanied in his capital; and was wont to say, "that a father has nothing to fear in the midst of his children." While he was besieging Gæta he dismissed the women and children that were turned out of the town without any injury, saying, "That he had rather lose any city in his dominions than lose the reputation of humanity." He leaped into a shallop for the relief of one of his galleys, which with its whole crew and soldiers was just about to perish, exclaiming, "I had rather share than witness their calamity." Such was his generosity, that upon hearing an officer who saw his treasurer bringing him 10,000 ducats, exclaiming, "I should only wish that sum to make me happy." "You shall be so," said Alphonso, and gave him the money in a present. He deemed dancing a certain degree of madness; but was strongly addicted to women, which involved him in many dishonourable intrigues, and justly entailed upon him the disgrace of an unfaithful husband to a kind and affectionate queen. (*Mod. Univ. Hist.*)

ALPHONSUS TOSTATUS, bishop of Avila, a learned and voluminous Spanish writer. He flourished about the middle of the 15th century, and by his uncommon abilities rose to the highest offices both in the civil and ecclesiastical departments of the state. At the age of 22 years he finished his studies at the university of Salamanca, having made great progress in every branch of learning then in estimation. He was present at the council of Basil, and was afterwards promoted to the bishopric of Avila. He died at the age of 40 years, in 1454, and was buried in the church of Avila. The following epitaph, expressive of his great erudition, was inscribed on his tomb.

Hic stupor est mundi qui scibile discutit omne.

"This is the wonder of the world who treated of every thing that could be known."

The numerous productions of Alphonsus are sufficient proofs of his laborious industry: during his life he wrote no less than 27 volumes in folio, of which 24 are commentaries on the Scriptures; the rest are on theological subjects. By the order of Cardinal Ximenes they were printed at Venice in 1530, and in 1596; and at Cologne in 1612. Several of his pieces on ecclesiastical history, science, and literature in general, were separately printed at Salamanca in 1506, and also his commentary upon the Chronicon of Eusebius. Although high encomiums have been bestowed upon his works, they have nevertheless in the current of time and human improvement fallen into oblivion. (*Dupin.*)

Alpini. ALPINI, Prospero, in Latin, *Prosper Alpinus*, a celebrated physician and botanist, was born at Marostica in the republic of Venice in November 1553. In his early years his inclination led him to the profession of arms, and he served some time in the Milanese. By the encouragement and persuasion of his father, who was a physician, he retired from the army, and devoted his attention to literature. To prosecute his studies with more advantage, he went to the university of Padua, where he was soon after elected deputy to the rector and syndic to the students. But in the discharge of his official duties which was distinguished by prudence and address, he was not prevented from pursuing the study of physic which he had chosen. He continued his medical studies with zeal and success; and after having acquired the necessary qualifications, he was admitted to the degree of doctor of medicine in 1578. Soon after he left the university, and settled as a physician in consequence of an invitation from the citizens in Campo San Pietro, a small town in the Paduan territory.

In the course of his studies he had paid particular attention to plants, and had become an enthusiast in botanical science. The sphere of his present practice was too limited to afford him much opportunity of prosecuting his favourite study. He wished particularly to extend his knowledge of exotic plants; and the only means to attain this, he thought, was to study their economy and habits in their native soil. And to gratify this laudable curiosity an opportunity soon presented itself. George Emo, the consul for the Venetian republic in Egypt, appointed Alpini his physician. They sailed from Venice in September 1580; and after having experienced a tedious and dangerous voyage, arrived at Grand Cairo in the beginning of July the following year. Alpini spent three years in Egypt, and by his industry and assiduity, greatly improved his botanical knowledge. With this view he travelled along the banks of the Nile, visited every place, and consulted every person from whom he expected any new information. From a practice in the management of date trees which he observed in this country, Alpini seems to have deduced the doctrine of the sexual difference of plants which was adopted as the foundation of the celebrated system of Linnæus. He says, "That the female date trees, or palms, do not bear fruit, unless the branches of the male and female plants are mixed together; or, as is generally done, unless the dust found in the male sheath, or male flowers, is sprinkled over the female flowers."

When Alpini returned to Venice in 1586 he was appointed physician to Andrea Doria prince of Melfi, and during his residence at Genoa, acquired so great a name as to be esteemed the first physician of his age. The Venetians became jealous that the Genoese state should number among its citizens a person of such distinguished merit and reputation, whose services might

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be eſſentially beneficial, and whoſe fame might be highly honourable to his native country. In the year 1593, he was recalled to fill the botanical chair in the univerſity of Padua, with a ſalary of 200 florins, which was afterwards augmented to 750. He diſcharged the duties of his profeſſorſhip for many years with great reputation, till his declining health interrupted his labours. He died in the year 1617, in the 64th year of his age, and was ſucceeded as botanical profeſſor by one of his ſons. Alpini wrote the following works in Latin: 1. *De Medicina Ægyptiorum, libri* iv. "Of the Phyſic of the Egyptians, in four books;" printed at Venice, 1591, in 4to. 2. *De Plantis Ægypti liber*: "A treatiſe concerning the plants of Egypt;" printed at Venice, 1592, in 4to. 3. *De Balſamo Dialogus*: "A dialogue concerning the Balm of Gilead;" printed at Venice, 1529, in 4to. 4. *De Præſagienda vita et morte ægrotantium libri* vii: "Seven books concerning the method of forming a judgment of the life or death of patients;" printed at Venice, 1691, in 4to. 5. *De Medicina methodica, libri* xiii: "Thirteen books concerning methodical Phyſic;" Padua, 1611, folio; Leyden, 1719, in 4to. 6. *De Rhapontico Diſputatio*: "A diſputation held in the ſchool at Padua concerning the Rhaponticum;" Padua, 1612, and 1629, in 4to. 7. *De Plantis Exoticis, libri* ii: "Of exotic plants, in two books;" Venice, 1699, in 4to. He left ſeveral other works, which have never been printed; particularly, 8. The fifth book concerning the phyſic of the Egyptians. 9. Five books concerning the natural hiſtory of things obſerved in Egypt, adorned with figures of plants, ſtones, and animals. (*Biog. Dict.*)

ALPINIA. See Botany *Index*.

ALPINUS. See Alpini.

ALPISTE, or Alpia, a ſort of ſeed uſed to feed birds with, eſpecially when they are to be nouriſhed for breeding. The alpiſte ſeed is of an oval figure, of a pale yellow, inclining to an iſabel colour, bright and gloſſy. It is an article of the corn-chandlers and ſeedſmen's trade.

ALPS, in *Ancient Geography*, a range of high mountains, ſeparating Italy from Gaul and Germany, in the form of a creſcent. They take their riſe from the Vada Sabatia, or Savona; and reach to the Sinus Flanaticus (now Golfo di Carnaro of the Adriatic), and the ſprings of the river Colapis (now the Kulpe); extending, according to Livy, 2000 ſtadia in length, or 250 miles: they are divided into ſeveral parts, and accordingly have different names. From Savona to the ſprings of the Varus, where the Alps lie againſt the ſea of Genoa, they are called *Maritime*, now *le Montagne di Tenda*. Theſe extend from ſouth to north, between Gaul to the weſt, and Genoa to the eaſt, beginning at Monaco on the Mediterranean; then running out through the eaſt of the county of Nice, and between that and the marquiſate of Saluzzo, terminate at length at Mount Viſo, between Dauphiné and Piedmont. Hence to Suſa run the *Alpes Cottiæ* (Sueton.) *Cottanæ* (Tacitus); mountains extremely high, ſeparating Dauphiné from Piedmont, and extending from Mount Viſo to Mount Cenis, between the *Alpes Maritimæ* to the ſouth, and the *Graiæ* to the north. The *Alpes Graiæ* (Pliny), ſo called from the paſſage of Hercules, begin from Mount Cenis, where the *Cottiæ* terminate; and run out between Savoy and the Tarenteſe to the

weſt, and Piedmont and the Duché d'Aouſte to the eaſt, quite to the Great St Bernard, where the *Alpes Penninæ* begin. They are alſo called by ſome *Graiæ Alpes*, and *Graius Mons* (Tacitus); which extend from weſt to eaſt, between St Bernard and the Adula, or St Gothard; and thus they run out between the Valaiſe to the north, and the Milaneſe to the ſouth. With theſe are continued the *Alpes Rheticæ*, to the head of the river Piave; a part of which are the *Alpes Tridentinæ*, to the north of Trent. To theſe join the *Alpes Noricæ*, reaching to Doblach in Tyrol, to the north of the river Tajamento: thence begin the *Alpes Carnicæ*, or of *Carniola*, extending to the ſprings of the Save: and the laſt, called *Alpes Pannonicæ*, and *Juliæ*, extend to the ſprings of the Kulpe. Some, however, extend the Alps to the north of Dalmatia; others, again, to Thrace and the Euxine. But their termination at the Kulpe, as above, is more generally received. They were formerly called *Albia*, and *Alpionia* (Strabo). Through theſe mountains Hannibal forced his paſſage into Italy, by pouring vinegar on the rocks, heated by burning large piles of wood on them, by which means they became crumbled, (Livy). They are covered with perpetual ſnow.

The Alps are the higheſt mountains in Europe; being, according to ſome geometricians, about two miles in perpendicular height. They begin at the Mediterranean; and ſtretching northward, ſeparate Piedmont and Savoy from the adjacent countries; whence directing their courſe to the eaſt, they form the boundary between Switzerland and Italy, and terminate near the extremity of the Adriatic ſea, north-eaſt of Venice. It was over the weſtern part of thoſe mountains, towards Piedmont, that Hannibal forced his paſſage into Italy.

The proſpect from many parts of this enormous range of mountains is extremely romantic, eſpecially towards the north-weſt. One of the moſt celebrated is the Grande Chartreuſe, where is a monaſtery founded by St Bruno about the year 1084. From Echelles, a little village in the mountains of Savoy, to the top of the Chartreuſe, the diſtance is ſix miles. Along this courſe, the road runs winding up, for the moſt part not ſix feet broad. On one hand is the rock, with woods of pine trees hanging over head; on the other a prodigious precipice almoſt perpendicular; at the bottom of which rolls a torrent, that, ſometimes tumbling among the fragments of ſtone which have fallen from on high, and ſometimes precipitating itſelf down vaſt deſcents with a noiſe like thunder, rendered yet more tremendous by the echo from the mountains on each ſide, concurs to form one of the moſt ſolemn, the moſt romantic, and moſt aſtoniſhing ſcenes in nature. To this deſcription may be added the ſtrange views made by the crags and cliffs, and the numerous caſcades which throw themſelves from the very ſummit down into the vale. On the top of the mountain is the convent of St Bruno, which is the ſuperior of the whole order. The inhabitants conſiſt of 100 fathers, with 300 ſervants, who grind their corn, preſs their wine, and perform every domeſtic office, even to the making of their clothes. In the Album of the fathers is an admired alcaic ode, written by the late ingenious Mr Gray when he viſited the Chartreuſe, and which has ſince been publiſhed among his works.

The glaciers of Savoy are alſo juſtly reckoned among the

the moſt ſtupendous works of nature. Theſe are immenſe maſſes of ice, lodged upon the gentler declivities amidſt the Alps, and exhibiting repreſentations beyond conception fantaſtic and picturesque. In the extraordinary narrative of M. Bourrit's journey hither, we meet with the following account of the Prieuré, in the valley of Chamouni. "We had (ſays he) the magnificent proſpect of a chain of mountains, equally inacceſſible, and covered with ice; and above the reſt that of Mount Blanc, whoſe top ſeemed to reach, and even pierce, the higheſt region of the clouds. The chain upon which this mountain looks down like a giant, is compoſed of maſſes of rocks, which terminate in pikes or ſpires, called the *Needles*, and which are ranged like tents in a camp. Their ſides appear lighter and more airy, from the ornament of ſeveral hollow breaks and furrows fretted in the rock itſelf, as well as from the different ſtreaks and panes of ice and ſnow, which, without changing the general character of their form, or the majeſty of their appearance, give them a picturesque variety. Lower down, the eye ſurveys with raviſhment the gills of ice, and the ſeveral glaciers, extending almoſt into the plain, whilſt this appears like an artificial garden, embelliſhed with the mixture of a variety of colours. We have a picturesque oppoſition to this chain, which is formed by innumerable mountains at the diſtance of near 50 leagues, between whoſe tops we have a glimpſe of thoſe ſeveral plains which they environ."

M. de Sauſſure, who had viſited thoſe mountains about two months before M. Bourrit, felt himſelf naturally electrified in this place. This extraordinary phenomenon ſeems not to have been experienced by the latter or his company; but they heard a long-continued rumbling noiſe like that of thunder, which was rendered more awful by the ſilence of the place where they ſtood. This noiſe proceeded from the ſubſequent cauſes, viz. the avalanches of ſnow, which ſeparated from the tops of the mountains, and rolled down to the bottom; conſiderable fragments of the rocks which followed them, overturning others in their fall; and maſſy blocks of ice, which precipitated from the ſummits.

The valley of Montanvert appears to be peculiarly romantic. "Here (ſays M. Bouritt) we behold a ſpacious icy plain entirely level. Upon this there roſe a mountain all of ice, with ſteps aſcending to the top, which ſeemed the throne of ſome divinity. It likewiſe took the form of a grand caſcade, whoſe figure was beyond conception beautiful; and the ſun, which ſhone upon it, gave a ſparkling brilliance to the whole. The valley on our right hand was ornamented with prodigious glaciers, that, ſhooting up to an immeaſurable height between the mountains, blend their colours with the ſkies, which they appear to reach."

Alps, beſides its proper ſignification, by which it denotes a certain chain of mountains which ſeparate Italy from France and Germany, is frequently uſed as an appellative to denote any mountains of extraordinary height or extenſive range. In this ſenſe, Auſonius and others call the Pyrenean mountains *Alps;* and Gellius the Spaniſh Alps, *Alpini Hiſpani*.

Hence alſo we ſay, the *Britiſh Alps*, the *Aſiatic Alps*, the *Alps of America*.

The *Scottiſh Alps* terminate in a moſt ſublime and abrupt manner, at the great promontory, the *Alta Ripa* of Ptolemy, the *Ord* or *Aird*, i. e. the *Height of Caithneſs*. The upper part is covered with gloomy heath; the lower is a ſtupendous precipice, excavated into vaſt caverns, the haunt of ſeals and different ſea fowl. On the eaſtern ſide of the kingdom, this is the ſtriking termination of the vaſt mountains of Scotland which form its Highlands, the habitation of the original inhabitants, driven from their ancient ſeats by the anceſtors of Lowland Scots, deſcendants of Saxons, French, and Normans; congenerous with the Engliſh, yet abſurdly and invidiouſly diſtinguiſhed from them. Language, as well as ſtriking natural boundaries, mark their place. Their mountains face on the weſt the Atlantic ocean; wind along the weſt of Caithneſs; among which Morven and Scaraben, Ben Hop, and Ben Lugal, ariſe pre-eminent. Sutherland is entirely alpine, as are Roſsſhire and Inverneſsſhire. Their *Summæ Alps* are, Meal-Fourvounich, the Coryariſh, Benewich, and Beneviſh near Fort William; the laſt of which is reported to be 1450 yards in height. Great part of Aberdeenſhire lies in this tract. It boaſts of another Morven, ſoaring far beyond the others. This is the centre of the Grampian hills, and perhaps the higheſt from the ſea of any in Great Britain. They again comprehend the eaſtern part of Perthſhire, and finiſh on the magnificent ſhores of Lochlomond; on the weſtern ſide of which Benlomond riſes, diſtinguiſhed among its fellows. From hence the reſt of North Britain forms a chain of humbler hills; but in Cumberland, part of Weſtmorland, Yorkſhire, Lancaſhire, and Derbyſhire, the Alps reſume their former majeſty. A long and tame interval ſucceeds. The long ſublime tract of Wales ariſes, the ancient poſſeſſion of the ancient Britiſh race. From the Ord, the great mountains recede inland, and leave a vaſt flat between their baſes and the ſea, fronting the waves with a ſeries of lofty rocky precipices, as far as the little creek of Staxigo; the whole a bold, but moſt inhoſpitable ſhore for ſhipping. Wick and Staxigo have indeed their creeks, or rather chaſms, which open between the cliffs, and may accidentally prove a retreat, unleſs in an eaſtern gale.

The *Aſiatic Alps* are deſcribed under the articles *Altaic Chain* and *Werturian Mountains*.

The *American Alps* are, The Andes or *Cordilleras*, in South America; and the Apalachian or *Allegany* mountains in North America.

The higheſt ground in North America is placed by Captain Carver in lat 47° W. Long, from London 98°, between a lake from which the Oregon flows, and another called *White-bear Lake*, from which ariſes the Miſſiſſippi.

This exalted ſituation is part of the Shining Mountains, which are branches of the vaſt chain which pervades the whole continent of America. It may be fairly taken from the ſouthern extremity, where Staten Land and Terra del Fuego riſe out of the ſea as inſulated links to an immenſe height, black, rocky, and marked with rugged ſpiry tops, frequently covered with ſnow. New Georgia may be added as another horribly congenial, riſing detached farther to the eaſt. The mountains about the ſtraits of Magellan ſoar to an amazing height, and infinitely ſuperior to thoſe of the northern hemiſphere under the ſame degree of latitude. From the north ſide of the ſtraits of Magellan,

lan, they form a continued chain through the kingdoms of Chili and Peru, preserving a course not remote from the Pacific ocean. The summits, in many places, are the highest in the world. There are not less than 12, which are from 2400 toises high to above 3000. Pichincha, which impends over Quito, is about 35 leagues from the sea; and its summit is 2430 toises above the surface of the water. Cayambe, immediately under the equator, is above 3000; and Chimborazo higher than the last by 200. Most of them have been volcanic, and in different ages marked with eruptions far more horrible than have been known in other quarters of the globe. They extend from the equator through Chili; in which kingdom is a range of volcanoes, from lat. 26. south, to 45. 30. and possibly from thence into Terra del Fuego itself; which, forming the straits of Magellan, may have been rent from the continent by some great convulsion, occasioned by their labourings, and New Georgia forced up from the same cause. An unparalleled extent of plain appears on their eastern side. The river of Amazons runs along a level clothed with forests, after it bursts from its confinement at the Pongo of Borjas, till it reaches its sea-like discharge into the Atlantic ocean.

In the northern hemisphere, the Andes pass through the narrow isthmus of Darien into the kingdom of Mexico, and preserve a majestic height and their volcanic disposition. The mountain Popocatepec made a violent eruption during the expedition of Cortez, which is most beautifully described by his historian Antonio de Solis. This is probably the same with the volcano observed by the Abbé d' Auteroche, in his way from Vera Cruz to Mexico; which, from the nakedness of the lavas, he conjectured to have been but lately extinguished. From the kingdom of Mexico, this chain is continued northward, and to the east of California; then verges so greatly towards the west, as to leave a very inconsiderable space between it and the Pacific ocean; and frequently detached branches jut into the sea, and form promontories; which, with parts of the chain itself, were often seen by our navigators in the course of their voyage. Some branches, as we have before observed, extend towards the east, but not to any great distance. A plain, rich in woods and savannahs, swarming with bisons or buffaloes, stags, and Virginian deer, with bears, and a great variety of game, occupies an amazing tract, from the great lakes of Canada, as low as the gulf of Mexico; and eastward to the other great chain of mountains, the Apalachian, which are the Alps of that side of northern America. Its commencement is supposed to be about Lake Champlain and Lake George, with branches pointing obliquely to the river St Lawrence eastward, and rising on its opposite coasts; others extending as far as Nova Scotia, but in their progress eastward diminish in height. The main chain passes through the province of New York, where it is distinguished by the name of the *Highlands*, and lies within 40 miles of the Atlantic. From thence it recedes from the sea, in proportion as it advances southward; and near its extremity in South Carolina is 300 miles distant from the water. It consists of several parallel ridges divided by most enchanting valleys, and generally clothed with variety of woods. These ridges rise gradually from the east, one above the other, to the central; from which they gradually fall to the west, into the vast plains of the Mississippi. The middle ridge is of an enormous bulk and height. The whole extends in breadth about 70 miles; and in many places leaves great chasms for the discharge of the vast and numerous rivers which rise in the bosoms of the mountains, and empty themselves into the Atlantic ocean, after yielding a matchless navigation to the provinces they water.

Beyond the branch of the Apalachian mountains called *The Endless*, is another of amazing extent, nearly as high as the mountains themselves. This plain (called the *Upper Plains*) is exceedingly rich land; begins at the Mohocks river; reaches to within a small distance of Lake Ontario; and to the westward forms part of the extensive plains of the Ohio, and reaches to an unknown distance beyond the Mississippi. Vast rivers take their rise, and fall to every point of the compass; into Lake Ontario, into Hudson's river, and into the Delaware and Susquehanna. The tide of Hudson's river flows through its deep-worn bed far up, even to within a small distance of the head of the Delaware; which, after a furious course down a long descent, interrupted with rapids, meets the tide not very remote from its discharge into the ocean.

Lower ALPS, Department of, in France. This department is one of four into which the former Provence is divided. It is bounded on the north by the department of the Upper Alps; on the east by Piedmont, and the department of the Maritime Alps; on the south, by the department of the Var, and the north-east extremity of that of the Mouths of the Rhone; and on the west, by the departments of Vaucluse and the Drome: the chief town is Digne; its superficies is about 1,459,699 square acres; population 144,436 individuals. It is divided into five communal districts.

Upper ALPS, Department of. This department makes a part of Dauphiné, which contains three. It is bounded on the north by the departments of Mont Blanc and Isere; on the east by Piedmont; on the south, by the department of the Lower Alps; on the west, by that of the Drome, and part of that of Isere: Embrun is the principal town; its superficies is about 1,084,614 square acres; population 116,754 individuals. It is divided into three communal districts.

Maritime ALPS, Department of. This department is formed of the county of Nice. It is bounded on the north by the Apennines and the department of the Lower Alps; on the east, by the republic of Genoa; on the south, by the Mediterranean; and on the west, by the departments of the Var and Lower Alps: the principal town is Nice; its superficies is about 632,619 square acres; population 93,366 souls. It is divided into three communal districts.

ALPUXARRAS, or ALPAXARES, mountains of Spain, in the province of Granada, on the coast of the Mediterranean sea. They are about 17 leagues in length and 11 in breadth, reaching from the city of Velez to Almeria. They are inhabited by Moors, who are the remains of the dispersion and ruin of their empire. They embraced the Christian religion; but preserve their own manner of living, and their language, though much corrupted. Here is a rivultet between

Pitros

Pitros and Portugos, which dyes linen that is dipped in it black in an inſtant. Near this rivulet is a cavern, from which proceeds ſo malignant a ſteam, that it deſtroys ſuch animals as come near it. The Moriſcos cultivate the ſoil extremely well, and plant fruit trees; ſome of which grow to a prodigious height and thickneſs, and give the mountains a very agreeable aſpect.

ALQUIER, a liquid meaſure uſed in Portugal to meaſure oil, two of which make an almond. See Almond.

ALQUIFOU, or Arquifou, is a ſort of lead ore, which, when broken, looks like antimony. It is uſed by the potters to give a green varniſh to their works, and thence is called *potters ore*. It is met with in Cornwall, &c. The potters mix a ſmall portion of manganeſe with the alquifou, and then the varniſh or glazing on their ware is of a blackiſh hue.

ALREDUS, Alured, or Aluredus, of Beverley, one of the moſt ancient Engliſh hiſtorians, was born at Beverley in Yorkſhire. He wrote in the reign of Henry I. There are no circumſtances of his life known with any degree of certainty. It is generally believed that he was educated at Cambridge, and that he afterwards became one of the canons and treaſurer of St John's at Beverley. And we learn in a note of Biſhop Tanner's, that, for the ſake of improvement, he travelled through France and Italy; and at Rome became domeſtic chaplain to Cardinal Othoboni. He died in the year 1128 or 1129, leaving behind him the following works: 1. The Annals of Alured of Beverley; which was publiſhed at Oxford in 1716, by Mr Hearne, from a manuſcript which belonged to Thomas Rawlinſon, Eſq. It contains an abridgment of our hiſtory from Brutus to Henry I. written in Latin, and with great accuracy, elegance, and perſpicuity. 2. *Libertates eccleſiæ S. Johannis de Beverlac*, &c. a manuſcript in the Cottonian library. It is a collection of records relative to the church of Beverley, tranſlated from the Saxon language. Theſe are the only works which were written by Alredus. (*Biog. Dict.*)

ALRESFORD, a town of Hampſhire, ſeated on the road from London to Southampton, cloſe by the river Itching, which feeds a great pond to the left of the town. Part of a Roman highway runs from hence to Alton. It conſiſts of about 200 houſes; has one church, and two principal ſtreets, which are large and broad; and has a ſmall manufacture of linens. It is 57 miles diſtant from London.

ALSA, in *Ancient Geography*, a river of Carniola (Pliny), now the *Auſa*, running by Aquileia, with a ſhort courſe from north to ſouth, into the Adriatic; where Conſtantine, the ſon of Conſtantine the Great, fighting againſt Conſtans his brother, loſt his life.

ALSACE, formerly a province of France, bounded on the eaſt by the Rhine, on the ſouth by Switzerland, on the weſt by Lorraine, and on the north by the palatinate of the Rhine. It was formerly a part of Germany, but was given to France by the treaty of Munſter. It is one of the moſt fruitful and plentiful provinces of Europe, abounding in corn, wine, wood, flax, tobacco, pulſe, fruits, &c. The mountains which divide it from Lorraine are very high; and generally covered with fir, beach, oak, and hornbeam. Thoſe on the ſide of Switzerland are leſs high; and furniſhed with all ſorts of wood, as well for fuel as building. The country itſelf is diverſified with riſing hills and fertile vales, beſides large foreſts; but that between the rivers Ill, Hart, and the Rhine, as far as Straſburg, is inferior to the reſt, on account of the frequent overflowing of the Rhine. In High Alſace there are mines of ſilver, copper, and lead. They however work none but thoſe of Giromany, from which are annually drawn 1600 marks of ſilver, each mark being eight ounces; and 24,000 pounds of copper: but the expence of working them is almoſt equal to the profit. There are iron works in ſeveral parts of Alſace, and particularly at Betford. There is a mineral ſpring at Sultſbach, near Munſter, in High Alſace; which is in great reputation for the palſy, weakneſs of the nerves, and the gravel.—The original inhabitants of Alſace are honeſt and good natured, but wedded to their own manners and cuſtoms. The fruitfulneſs of their country renders them indolent and inactive; for the Swiſs make their hay and reap their corn, as well as manage the vintage of High Alſace, which ſends a great deal of money out of the province. The common language is the German; but the better ſort of people in the towns ſpeak French; and, even in the country, they ſpeak French well enough to be underſtood.

The number of inhabitants was formerly computed at about half a million, who are moſtly Lutherans and Roman Catholics. By the late diviſion of France this province forms two departments, viz. thoſe of the Upper and Lower Rhine; the capital of the former being Colmar, and that of the latter Straſburg; but formerly it was divided into Upper and Lower Alſace, the former contained 32 large and ſmall towns, and the latter 39, and in both there are upwards of 1000 market towns and villages. The Rauraci, Sequani, and Mediomatrici, were the ancient inhabitants of this province. Under the Merovingian kings its name firſt occurs in the hiſtory of France, and it moſt probably is derived from the river Ell or Ill, the inhabitants on the borders of which were called *Elſaſſon*, from whom the country itſelf was afterwards denominated *Elſas*, in Latin *Eliſatia*, *Aliſatia*, and *Alſatia*. The Romans wreſted it from the Celtæ; from them it paſſed into the hands of the Germans; and after the famous battle of Tolbiac, gained by Clovis in 496, it paſſed into the poſſeſſion of the Franks. It was incorporated at a future period with the kingdom of Auſtraſia; and, in 1752, it was ſubjected, like the reſt of the monarchy, to the laws of Pepin and his ſucceſſors. Lotharius, the eldeſt ſon of Lewis Debonnaire, at the deceaſe of his father in 840, obtained it and united it to that part of the empire of the Franks which fell to him, and was generally known by the name of *Lotharingia*, or *Lorraine*. Afterwards it fell to his youngeſt ſon Lotharius by inheritance, and after him, in 869, it became a province of Germany, and was governed by dukes.

About a century before the title of dukes was aboliſhed, the provincial counts who governed under them in Alſace, aſſumed the title of *Landgraves*, and the countries over which they preſided, obtained the name of *Landgravates*, the one ſuperior and the other inferior. The beſt part of the inferior was conveyed to the biſhops of Straſburg in 1375, who aſſumed the title

title of *Landgrave of Alsace*. In after times, the government was given by the emperors to several families, until at last Ferdinand I. bestowed it upon the German line of his own family, and consequently it remained in the house of Austria. The property of the town of Brisac, the landgravate of the Upper and Lower Alsace, Sundgau, and the districts of the ten united imperial cities in Alsace, with the whole sovereignty belonging to them, was for ever ceded by the emperor to the crown of France, at the peace of Munster in 1648. The perpetual sovereignty of the city of Strasburg, together with all its dependencies on the left of the Rhine, were ceded to France by the peace of Ryswick in 1697.

ALSEN, an island of Denmark, situated in the Lesser Belt, or entrance into the Baltic sea, between Sleswick and Funen, 100 miles west of Copenhagen. It extends in length six leagues, and about two in breadth. The soil is fertile, producing abundance of fruit and variety of grain, with large crops of aniseeds, a carminative much used in seasoning the food and mixing with the bread all over the Danish dominions. E. Long. 10. 12. N. Lat. 55. 12.

ALSFIELD, a town of Germany, in the landgravate of Hesse Cassel, ten miles north-west of Marpurg, and 35 south of Hesse Cassel. It is an ancient town, and well built; and the inhabitants were the first of this country who embraced the Reformation. E. Long. 9. 5. N. Lat. 50. 40.

ALSHASH, a very beautiful city in Buckharia, supposed to be the same with that which is now called *Tashcant*, the capital of the eastern part of Turkestan, possessed by the Kassats. It is situated on the river *Sihûn*, now *Sîr*, and had a well watered garden for every house; but was ruined by Jenghiz Khan, who took the city, and caused a great number of its inhabitants to be massacred.

ALSHEDA, a parish in the province of Smaland, in Sweden, where a gold mine was discovered in 1738.

ALSINA, in *Botany*, a synonyme of the theligonum. See Theligonum, Botany *Index*.

ALSINASTRUM, in *Botany*, the trivial name of the elatine. See Elatine, Botany *Index*.

ALSINE, or Chickweed. See Botany *Index*.

The common chickweed affords a remarkable instance of what is called the *sleep of plants*; for, every night, the leaves approach in pairs, so as to include within their upper surfaces the tender rudiments of the new shoots; and the uppermost pair but one at the end of the stalk are furnished with longer leaf-stalks than the others; so that they can close upon the terminating pair, and protect the end of the branch.

ALSIRAT, in the *Mahometan Theology*, denotes a bridge laid over the middle of hell, finer than a hair, and sharper than the edge of a sword, over which people are to pass, after their trial, on the day of judgement. To add to the difficulty of the passage, Mahomet assures, that the alsirat, narrow as it is, is beset with briars and thorns; none of which, however, will be any impediment to the good, who shall fly over it like the wind, Mahomet and his Mussulmans leading the way; whereas the wicked, by the narrowness of the path, the entangling of the thorns, and extinction of the light which directed the former to paradise, will soon miss their footing, and tumble headlong into hell, which is gaping beneath to receive them.

ALSIUM, in *Ancient Geography*, a city of ancient Etruria, occupying (according to Cluverius) the spot on which *Pala* now stands. We are told by Dionysius Halicarnassensis, that Alsium was built by the Aborigines, long before the Tyrrhenians invaded Italy. In this case it must have been founded not long after the dispersion in the days of Peleg. Its founder is said to have been one *Alæsus*, *Alesus*, or *Alisa*; whom some conjecture to have been Alisah, or Elisha, the son of Javan, mentioned in Scripture.

ALSOP, Anthony, an English divine and poet, was educated at Westminster school, and from thence elected to Christ-church, Oxford, where he took the degree of M. A. in March 1696, and of B. D. in December 1706. On his coming to the university, he was very soon distinguished by Dean Aldrich, and published *Fabularum Æsopicarum Delectus*, Oxon. 1698, 8vo, with a poetical dedication to Lord Viscount Scudamore, and a preface in which he took part against Dr Bentley in the famous dispute with Mr Boyle. He passed through the usual offices in his college to that of censor with considerable reputation; and for some years had the principal noblemen and gentlemen belonging to the society committed to his care. In this employment he continued till his merit recommended him to Sir Jonathan Trelawney, bishop of Winchester, who appointed him his chaplain, and soon after gave him a prebend in his own cathedral, together with the rectory of Brightwell in the county of Berks, which afforded him ample provision for a learned retirement, from which he could not be drawn by the repeated solicitations of those who thought him qualified for a more public character and a higher station. In 1717 an action was brought against him by Mrs Elizabeth Astrey of Oxford, for a breach of a marriage contract; and a verdict obtained against him for 2000l. which probably occasioned him to leave the kingdom for some time. His death, which happened June 10, 1726, was occasioned by his falling into a ditch that led to his garden door. A quarto volume was published in 1752, under the title of *Antonii Alsopi, Ædis Christi olim Alumni, Odarum libri duo*. Four English poems of his are in Dodsley's Collection, one in Pearch's, several in the early volumes of the Gentleman's Magazine, and some in "The Student." Mr Alsop is respectfully mentioned by the facetious Dr King of the Commons (Vol. I. p. 236), as having enriched the commonwealth of learning, by "Translations of Fables from Greek, Hebrew, and Arabic;" and not less detractingly by Dr Bentley, under the name of "Tony Alsop, a late editor of the Æsopean Fables." (*Biog. Dict.*)

Alsop, *Vincent*, an English nonconformist divine, was born in Northamptonshire, and educated at St John's college, Cambridge, where he took the degree of Master of Arts. When he received deacon's orders, he went to Rutlandshire, and settled at Oakham, where he was an assistant to the master of the free-school. As he was a man of a sprightly turn, he fell into indifferent company; but was reclaimed by the frequent admonitions of the Reverend Mr Benjamin King. He afterwards married that gentlemen's daughter, and becoming a convert to his principles, received ed ordination in the Preſbyterian way, not being ſatisfied with that which he had from the biſhop. He was ſettled at Wilbee in the county of Northampton, whence he was ejected in 1662, for nonconformity. After this he ventured to preach ſometimes at Oakham, and at Wellingborough where he lived, and was once ſix months in priſon for praying by a ſick perſon. A book he wrote againſt Dr Sherlock in a humorous ſtyle, made him well known to the world, and induced Mr Cawton, an eminent nonconformiſt in Weſtminſter, to recommend him to his congregation for his ſucceſſor. On receiving this call he quitted Northamptonſhire, and came to London, where he preached conſtantly, and wrote ſeveral pieces which were extremely well received by the public. His living in the neighbourhood of the court expoſed him to many inconveniences; but theſe ended with the reign of Charles II. or at leaſt in the beginning of the next reign, when Mr Alſop's ſon engaging in treaſonable practices was freely pardoned by King James. After this our divine went frequently to court, and is generally ſuppoſed to have been the perſon who drew the Preſbyterians addreſs to that prince for his general indulgence. After the Revolution, Mr Alſop gave public teſtimonies of his attachment to government; yet upon all occaſions he ſpoke very reſpectfully of King James and retained a very high ſenſe of his clemency in ſparing his only ſon. The remainder of his life he ſpent in the exerciſe of his miniſtry, preaching once every Lord's day; beſides which he had a Thurſday lecture, and was one of the lecturers at Pinner's hall. He lived to a great age, and preſerving his ſpirits to the laſt, died in May 1703. On grave ſubjects he wrote with a becoming ſeriouſneſs: but where wit might properly be ſhown, he diſplayed it to great advantage. His funeral ſermon was preached by Mr Slater, and his memory will be always preſerved by his own learned and elegant writings. Of theſe the moſt remarkable, beſides his ſermons, are, 1. *Antiſozzo;* in vindication of ſome great truths oppoſed by Dr William Sherlock, 8vo, 1675. 2. *Melius Inquirendum;* in anſwer to Dr Goodman's Compaſſionate Inquiry, 8vo, 1679. 3. The Miſchief of Impoſitions; in anſwer to Dr Stillingfleet's Miſchief of Separation, 1680. 4. A faithful Reproof to a Falſe Report, with reference to the Differences among the United Miniſters in London, 8vo. (*Biog. Brit.*)

ALSTEDIUS, John Henry, a German Proteſtant divine, and one of the moſt indefatigable writers of the 17th century. He was ſome time profeſſor of philoſophy and divinity at Herborn in the county of Naſſau: from thence he went into Tranſylvania, to be profeſſor at Alba Julia; where he continued till his death, which happened in 1638, in the 50th year of his age. His *Encyclopedia* has been much eſteemed even by the Roman Catholics; it was printed at Lyons, and ſold very well throughout all France. His *Theſaurus Chronologicus* is by ſome conſidered as one of his beſt works, and has gone through ſeveral editions. He alſo wrote *Triumphus Biblicus*, to ſhow that the principles of all arts and ſciences are to be found in the ſcriptures. He was a Millenarian; and publiſhed, in 1627, a treatiſe *De mille annis*, in which he aſſerted that the reign of the ſaints on earth was to begin in 1694.

ALSTON, Charles, M. D. a botanical and medical writer, was born in the weſt of Scotland in the year 1683. He began his ſtudies at the univerſity of Glaſgow, and about this period he had the good fortune to be taken under the patronage of the ducheſs of Hamilton, which afforded him an opportunity of purſuing the bent of his inclination, by attaching himſelf to the ſtudy of phyſic. About the age of 33, along with his friend and companion the celebrated Alexander Monro, he went to Leyden, and ſtudied three years under Boerhaave. On their return to their native country, they, in conjunction with Rutherford, Sinclair, and Plummer, undertook departments in the college of Edinburgh, and by their abilities and induſtry, laid the foundation of that ſchool of phyſic. The branches of botany and materia medica, were long the favourite ſtudies of his life, conſequently he undertook that department, and continued to lecture on them with increaſing reputation until his death, which happened in November 1760, at the age of 77 years. His talents appear to have been naturally ſtrong, which he improved and ſtrengthened with great aſſiduity and induſtry, and employed them ſucceſsfully in the ſervice of ſcience. In the year 1753, his diſſertation on the ſexes of plants, in which he combats the doctrine of Linnæus, was publiſhed in the firſt volume of the Edinburgh Phyſical and Literary Eſſays. The general plan of the work is conducted with much ingenuity, ſupported by ſome ſtrong experiments, and although in the opinion of the learned, it has failed in its principal deſign, yet it muſt be acknowledged to be one of the beſt argued pieces on that ſide of the queſtion. An aſperity of language is ſometimes uſed, very unſuitable to a ſcientific topic; but, however, it is proper to remark, that Linnæus had given ſome reaſons for this conduct by the nature of ſome of his deſcriptions. In the fifth volume of the Edinburgh Medical Eſſays, we have a ſhort paper by Dr Alſton on the efficacy of the powder of tin, to deſtroy or expel worms from the bowels. He informs us, that he received the preſcription from an empyric, who was renowned for his ſkill in curing perſons afflicted with that diſeaſe. The patient received the firſt morning one ounce of tin reduced to powder, and half an ounce each of the two following mornings, and was then purged with the infuſion of ſenna and manna. He ſpeaks with great certainty upon the efficacy of this medicine, which certainly has conſiderable power in theſe caſes, and may be given to the moſt delicate ſubjects with perfect ſafety. Dr Alſton alſo engaged in a chemical controverſy reſpecting quicklime with Dr Whytt. But the moſt valuable of all his works, are his lectures on the Materia Medica, which were publiſhed in the year 1770, in two volumes 4to. The number of curious and uſeful facts contained in this book, will tend to ſecure its reputation, although conſiderable additions and improvements have been made, ſince that period, in this branch of ſcience. (*Gen. Biog.*)

ALSTON-MOOR, a town in Cumberland, ſeated on a hill, at the bottom of which runs the river Tyne, with a ſtone bridge over it. Near this place is plenty of lead ore. W. Long. 2. 4. N. Lat 54. 45.

ALSTONIA. See Botany *Index*.

ALSTROEMERIA. See BOTANY *Index*.

ALT, in *Music*, a term applied to the high notes in the ſcale.

ALTAI MOUNTAINS, an extenſive range of mountains in the northern parts of Aſia. It begins at the vaſt mountain Bogdo, paſſes above the head of the Irtiſch, and then takes a courſe rugged, precipitous, clothed with ſnow, and rich in minerals, between the Irtiſch and Oby; then proceeds by the lake Telezkoi, the riſe of the Oby; after which it retires, in order to comprehend the great rivers which form the Jeneſei, and are locked up in theſe high mountains; finally under the name of the *Sainnes*, it is uninterruptedly continued to the lake of Baikal. A branch inſinuates itſelf between the ſources of the rivers Onon and Ingoda, and thoſe of Ichikoi, accompanied with very high mountains, running without interruption to the north-eaſt, and dividing the river Amur, which diſcharges itſelf into the eaſt, in the Chineſe dominions, from the river Lena and lake Baikal. Another branch ſtretches along the Olecma, croſſes the Lena below Jakoutſk, and is continued between the two rivers Tougouſka to the Jeneſei, where it is loſt in wooded and moraſſy plains. The principal chain, rugged with ſharp-pointed rocks, approaches and keeps near the ſhores of the ſea of Ockhotz, and paſſing by the ſources of the rivers Outh, Aldan, and Maia, is diſtributed in ſmall branches, which range between the eaſtern rivers which fall into the Icy ſea; beſides two principal branches, one of which, turning ſouth, runs through all Kamtſchatka, and is broken, from the Cape Lopatka, into the numerous Kurile iſles, and to the eaſt forms another marine chain, in the Aleutian iſlands which range from Kamtſchatka to America; moſt of them, as well as Kamtſchatka itſelf, diſtinguiſhed by volcanoes, or the traces of volcanic fires. The laſt chain forms chiefly the great Cape Tſchutſki, with its promontories and rocky broken ſhores.

The ſummits of the higheſt of the Altai mountains are covered with perpetual ſnow. The lofticſt range of this extenſive chain, is compoſed of granite. Another range of inferior height conſiſts of ſhiſtus, which lies on the ſides of the granite mountains. Beſide theſe rocks, there are ſtrata of chalkſtone, limeſtone, and marble. The Altai mountains abound in metallic ores. Gold, ſilver, and lead mines, have been diſcovered in them, with great abundance of copper and iron. The two latter have been wrought to a conſiderable extent, and have been found productive.

ALTAMONT, a very handſome town of Italy, in the kingdom of Naples, and in Calabria Citerior, 15 miles north-weſt of Baſigniano. E. Long. 16. 22. N. Lat. 39. 40.

ALTAMURA, a town of Naples, in the territory of Bari, with the title of a principality, ſeated on the foot of the Apennine mountains. E. Long. 16. 54. N. Lat. 41. 0.

ALTAR, a place upon which ſacrifices were anciently offered to ſome deity.

The heathens at firſt made their altars only of turf; afterwards they were made of ſtone, of marble, of wood, and even of horn, as that of Apollo in Delos.

Altars differed in figure as well as in materials. Some were round, others ſquare, and others triangular. All of them were turned towards the eaſt, and ſtood lower than the ſtatues of the gods; and were generally adorned with ſculpture, repreſenting either the gods to whom they were erected, or their ſymbols. See the PAGAN ALTARS repreſented on Plate XVII. Upon the ſides of fig. 1. a trident and two dolphins are exhibited, which denote it to have been dedicated to Neptune. Fig. 2. a four-ſquare altar, was dedicated to the Nymphs, as the inſcription imports. Fig. 3. exhibits a Bacchanal holding a thyrſus in his hand, a mark of the altar's being built to Bacchus: it had two other ſides, which made it appear triangular. Of fig. 4. which was alſo triangular, each face or ſide exhibited a genius, one of whom (on the ſide repreſented) carries an oar upon his neck, which ſeems to denote it an altar of Neptune. Fig. 5. an altar of a round ſhape, is inſcribed *Ara Neptuni*: the god himſelf is there repreſented, all naked, ſaving the pallium upon his ſhoulder; and holding in his left hand a trident, and in his right a dolphin.

The height of altars alſo differed according to the different gods to whom they ſacrificed. According to Servius, thoſe altars ſet apart for the honour of the celeſtial gods, and gods of the higher claſs, were placed on ſome pretty tall pile of building; and for that reaſon were called *altaria*, from the words *alta* and *ara*, "a high elevated altar." Thoſe appointed for the terreſtrial gods were laid on the ſurface of the earth, and called *aræ*. And, on the contrary, they dug into the earth and opened a pit for thoſe of the infernal gods, which they called ϐοθϱοι λακκοι, *ſcrobiculi*. But this diſtinction is not everywhere obſerved: the beſt authors frequently uſe *ara* as a general word, under which are included the altars of the celeſtial and infernal, as well as thoſe of the terreſtrial gods. Witneſs Virgil, Ecl. 5.

——*En quatuor aras*,

where *aræ* plainly includes *altaria*; for whatever we make of Daphnis, Phœbus was certainly a celeſtial god. So Cicero, pro Quint. *Aras delubraque Hecates in Græcia vidimus*. The Greeks alſo diſtinguiſhed two ſorts of altars; that whereon they ſacrificed to the gods was called βωμος, and was a real altar, different from the other whereon they ſacrificed to the heroes, which was ſmaller, and called εσχαϱα. Pollux makes this diſtinction of altars in his Onomaſticon; he adds, however, that ſome poets uſed the word εσχαϱα for the altar whereon ſacrifice was offered to the gods. The Septuagint verſion does ſometimes alſo uſe the word εσχαϱα for a ſort of little low altar, which may be expreſſed in Latin by *craticula*; being a hearth rather than an altar.

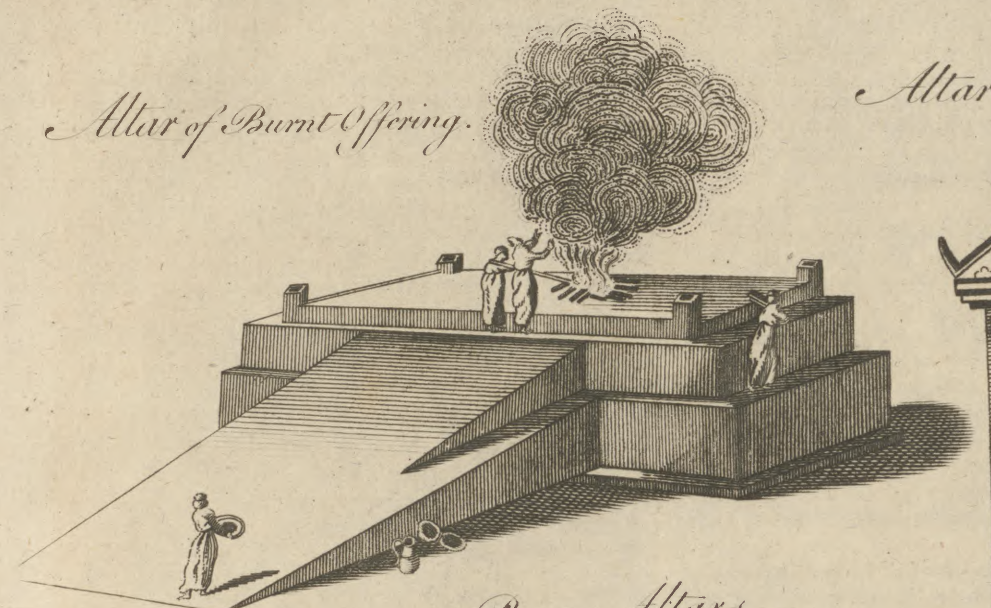
Before temples were in uſe, altars were erected ſometimes in groves, ſometimes in the highways, and ſometimes on the tops of mountains; and it was a cuſtom to engrave upon them the name, enſign, or character of the deity to whom they were conſecrated.

In the great temples of ancient Rome there were ordinarily three altars: The firſt was placed in the ſanctuary, at the foot of the ſtatue of the divinity, upon which incenſe was burnt and libations offered; the ſecond was before the gate of the temple, and upon it they ſacrificed the victims; and the third was a portable altar, upon which were placed the offering and the ſacred veſſels.

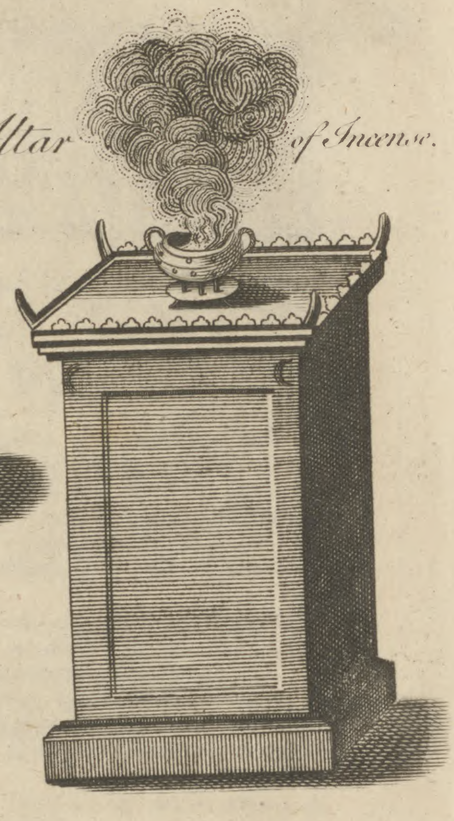
ALTAR.

Jewish Altars.

Altar of Burnt Offering.



Altar of Incense.



Pagan Altars.

Fig. 1.

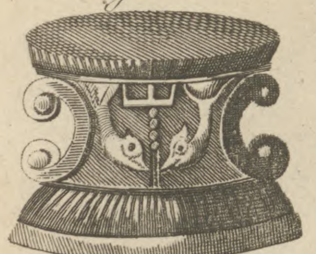


Fig. 2.

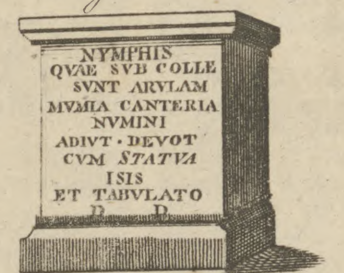


Fig. 3.

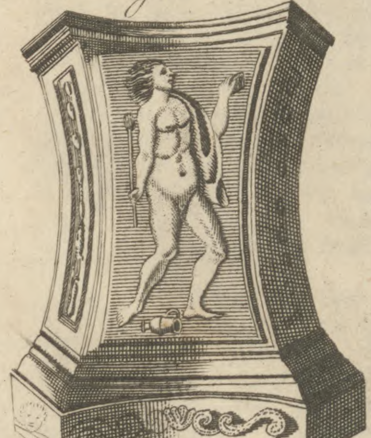


Fig. 4.

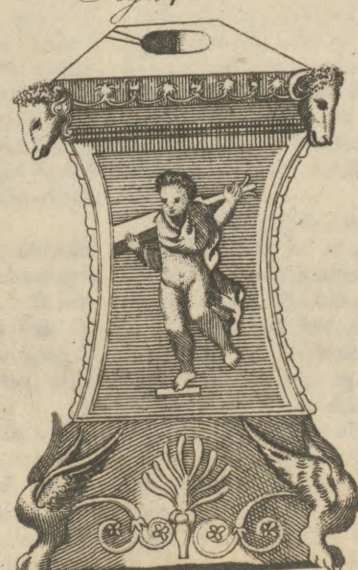


Fig. 5.

A. Bell Prin. Wal. Sculptor fecit.

Besides these uses of altars, the ancients swore upon them, and swore by them, in making alliances, confirming treaties of peace, and other solemn occasions. Altars also served as places of refuge to all those who fled to them, whatever crime they had committed.

Altars are doubtless as ancient as sacrifices themselves; consequently their origin is not much later than that of the world, Gen. ch. iv. Some attribute their origin to the Egyptians; others to the Jews; others to the patriarchs before the flood. Some carry them as far back as Adam, whose altar is much spoken of by Jewish, and even Christian writers. Others are contented to make the patriarch Enoch the first who consecrated a public altar. Be this as it will, the earliest altars we find any express testimony of are those erected by Abraham.

Altars, in the patriarchal times, were very rude. The altar which Jacob set up at Bethel was nothing but a stone, which served him instead of a bolster; that of Gideon, a stone before his house: and the first which God commanded Moses to erect was probably of earth or unpolished stones, without any iron; for if any use was made of that metal, the altar was declared impure.

The principal altars of the Jews were, The altar of *incense;* that of *burnt-offering;* and the *altar*, or *table, for the shew-bread.*

The *altar of incense* was a small table of shittim wood, covered with plates of gold, of one cubit in length, another in width, and two in height. At the four corners were four kinds of horns, and all round a little border or crown over it. This was the altar hidden by Jeremiah before the captivity; and upon it the officiating priest offered, every morning and evening, incense of a particular composition. See Plate XVII.

The *altar of burnt-offerings* was made of shittim wood, and carried upon the shoulders of the priests by staves of the same wood overlaid with brass. In the time of Moses, this altar was five cubits square and three high; but in Solomon's temple it was much larger, being 20 cubits square and 10 in height. It was covered with brass; and at each corner was a horn or spire, wrought out of the same wood with the altar, to which the sacrifices were tied. Within the hollow was a grate of brass, on which the fire was made; through it fell the ashes, which were received in a pan below. At the four corners of the grate were four rings and four chains, which kept it up at the horns. This altar was placed in the open air, that the smoke of the burnt-offerings might not sully the inside of the tabernacle. See Plate XVII.

The *altar* or *table* for the *shew-bread* was likewise of shittim wood, covered with plates of gold, having a little border round it, adorned with sculpture. It was two cubits long, one wide, and one and a half in height. Upon this table, which stood in the holy of holies, were put, every Sabbath day, 12 loaves, with salt and incense.

The Jewish altars, after their return from the captivity, and the building of the second temple, were in some respects different from those described above. That of burnt offerings was a large pile, built of unhewn stone, 32 cubits square at the bottom, and 24 square at the top. The ascent was by a gentle rising, 32 cubits in length, and 16 in breadth.

Altar, is also used among Christians for the communion-table.

In the primitive church, the altars were only of wood; as being frequently to be removed from place to place. But the council of Paris, in 509, decreed that no altar should be built but of stone. At first there was but one altar in each church; but the number soon increased; and from the writings of Gregory the Great, who lived in the sixth century, we learn, that there were sometimes in the same church twelve or thirteen. In the cathedral of Magdeburg there are no less than 49 altars.

The altar is sometimes sustained on a single column, as in the subterraneous chapels of St Cecilia, at Rome, &c.; and sometimes by four columns, as the altar of St Sebastian of Crypta Arenaria; but the customary form is, to be a massive of stone work, sustaining the altar table. These altars bear a resemblance to tombs: to this purpose, we read in church-history, that the primitive Christians chiefly held their meetings at the tombs of the martyrs, and celebrated the mysteries of religion upon them: for which reason, it is a standing rule to this day in the church of Rome, never to build an altar, without inclosing the relics of some saint in it.

ALTAR-thane, or Altarist, in *old Law-books*, an appellation given to the priest or parson of a parish, to whom the altarage belonged. See Altarage.

ALTARAGE, in *Law*, altars erected in virtue of donations, before the Reformation, within a parochial church, for the purpose of singing of mass for deceased friends.

Altarage likewise signifies the profits arising to the priest on account of the altar.

AL-TAYEFF, a town of Hejaz, a district of Arabia Felix. It is situated about sixty miles east of Mecca, behind Mount Gazwan, where the cold is more intense than in any other part of the district, but the air very wholesome. Its territory abounds in fountains, and produces excellent raisins. The town is surrounded with a wall, but is not very large.

ALTDORF, a large handsome town in Swisserland, and the chief of the canton of Uri. It is situated below the lake of the Four Cantons, in a plain, at the foot of a mountain whose passages are difficult, and serve instead of fortifications. It has four churches and two convents; St Martin's church and that of the Holy Cross are the finest. The town-house and the arsenal are also worth seeing. E. Long. 8. 30. N. Lat. 46. 50.

ALTEA, a sea-port town of Valencia, in Spain. It was taken in 1705, in favour of the archduke Charles; but lost after the battle of Almanza. W. Long. 0. 15. N. Lat. 46. 34.

ALTEMBURG, a town of Transylvania, 17 miles south-west of Wisemburg, and 35 south of Clausenbourg. E. Long. 23. 5. N. Lat. 46. 25.

ALTENA, or Altona, a sea-port town of Germany, in the duchy of Holstein in Lower Saxony. It is a modern town, built by the king of Denmark, and was burnt by the Swedes in 1712; but has since been beautifully rebuilt. The merchandise brought from Asia by the Danish East India Company is sold here. E. Long. 10. 0. N. Lat. 53. 51.

ALTENBERG, an ancient town of Germany, situated

ſituated on the river Pleiſs, with a good caſtle placed on a rock, in Miſnia, in the circle of Upper Saxony. It was formerly an imperial city, but at preſent belongs to the houſe of Saxony. Here is a college which has always been in a flouriſhing condition. In 1705, there was a nunnery founded for women of a high rank, who are Proteſtants. E. Long. 15. 8. N. Lat. 50. 59.

ALTENBURG, a ſmall fortified town of Hungary, in the territory of Moſon, near the Danube, about fifty-five miles from Vienna. E. Long. 35. 30. N. Lat. 48. 15.

Altenburg, or Owar, a ſmall but ſtrong town of Hungary, ſeated in a marſh, with wide ſtreets. It is near the river Danube, and is ſurrounded with deep ditches. It is 15 miles ſouth of Preſburg, 40 ſouth-eaſt of Vienna, and 65 ſouth-weſt of Buda. E. Long. 17. 56. N. Lat. 44. 0.

ALTERANTS, or *Alterative Medicines*, ſuch as correct the bad qualities of the blood and other humours, without occaſioning any ſenſible evacuation.

ALTERATION, in *Phyſics*, the act of changing the circumſtances and manner of a thing; its general nature and appearance remaining the ſame. Or, it is an accidental and partial change in a body; without proceeding ſo far as to make the ſubject quite unknown, or to take a new denomination thereupon. Or, it may be defined, the acquiſition or loſs of ſuch qualities as are not eſſential to the form of the body. Thus, a piece of iron, which before was cold, is ſaid to be *altered*, when it is made hot; ſince it may ſtill be perceived to be iron, is called by that name, and has all the properties thereof. By this *alteration* is diſtinguiſhed from *generation* and *corruption;* thoſe terms expreſſing an acquiſition or loſs of the eſſential qualities of a thing. The modern philoſophers, after the ancient chemiſts and corpuſcularians, hold all *alteration* to be effected by means of local motion. According to them, it always conſiſts either in the emiſſion, acceſſion, union, ſeparation, or tranſpoſition, of the component particles.

ALTERCATION, a debate or conteſt between two friends or acquaintance. The word comes from *altercari*, which anciently ſignified to converſe or hold diſcourſe together. Thus we ſay, They never come to an open quarrel, but there is continually ſome little *altercation* or other.

ALTERN-base, in *Trigonometry*, a term uſed in contradiſtinction to the true baſe. Thus in oblique triangles, the true baſe is either the ſum of the ſides, and then the *difference* of the ſides is called the *altern-baſe;* or the true baſe is the difference of the ſides, and then the *ſum* of the ſides is called the *altern-baſe.*

ALTERNATE, in a general ſenſe, a term applied to ſuch perſons or things as ſucceed each other by turns. Thus, two who command each his day, are ſaid to have an alternate command, or to command alternately.

Alternate, in *Heraldry*, is ſaid in reſpect of the ſituation of the quarters. Thus the firſt and fourth quarters, and the ſecond and third, are uſually of the ſame nature, and are called *alternate quarters.*

Alternate, in *Botany*, when the leaves or branches of plants ariſe higher on oppoſite ſides alternately.

ALTERNATION, in its primary ſenſe, denotes a ſucceſſion by turns.

Alternation is ſometimes uſed to expreſs the different changes or alterations of orders in any number of things propoſed. This is alſo called *permutation*, &c. and is eaſily found by a continual multiplication of all the numbers, beginning at unity. Thus, if it be required to know how many changes or alternations can be rung on ſix bells, multiply the numbers 1, 2, 3, 4, 5, 6, continually into one another; and the laſt product gives the number of changes.

ALTERNATIVE, is particularly uſed for the choice of two things propoſed. In this ſenſe we ſay, to take the *alternative* of two propoſitions.

ALTHÆA, Marshmallow. See Botany *Index*.

Althæa Frutex. See Hibiscus, Botany *Index*.

ALTIMETRY, the art of meaſuring altitudes or heights, whether acceſſible or inacceſſible. See Geometry.

ALTIN, a money of account in Muſcovy, worth three *copecs;* one hundred of which make a ruble, worth about 4s. 6d. Sterling.

ALTIN, a lake in Siberia, from whence iſſues the river Ob, or Oby, in N. Lat. 52. 0. E. Long. 85. 55. This lake is called by the Ruſſians *Teloſkoi Oſero*, from the Teleſſi, a Tartarian nation, who inhabit the borders of it, and who give it the name of *Altin-Kul.* By the Calmucks it is called *Altinnor.* It is near 90 miles long and 50 broad, with a rocky bottom. The north part of it is ſometimes frozen ſo hard as to be paſſable on foot, but the ſouthern part is never covered with ice. The water in the Altin lake, as well as in the rivers which run through the adjacent places, only riſes in the middle of ſummer, when the ſnows on the mountains are melted by the heat of the ſun.

ALTINCAR, among *Mineraliſts*, a ſpecies of factitious ſalt uſed in the fuſion and purification of metals.

The altincar is a ſort of flux powder. Divers ways of preparing it are given by Libavius.

ALTING, Henry, a German divine, was born at Embden, in 1583. His father was miniſter of the church of Embden, and early deſtined his ſon to the ſame profeſſion. In the year 1602, after a grammatical courſe he was ſent to the univerſity of Herborn: there he ſtudied with ſo much aſſiduity and ſucceſs, that he ſoon had the honour of being a preceptor. Qualified by the vigorous exertions of his talents, he was appointed tutor to the three young counts of Naſſau, Solms, and Iſenburg, who ſtudied with the elector prince palatine, firſt at Sedan, and afterwards at Heidelberg. A proper diſcharge of the duties of a lower ſtation generally paves the way for a higher. For he was appointed preceptor to the prince in 1608: and in conſequence of his aſſiduity and ſucceſs, he was choſen to accompany the elector into England. Among the number of celebrated men to whoſe acquaintance he was introduced in England, was the famous Dr Abbot, archbiſhop of Canterbury. In 1613, Alting returning to Heidelberg after the marriage of the elector with the princeſs of England, received his degree of doctor of divinity, and was appointed director of the college of Wiſdom. The increaſed knowledge and invigorated talents of Alting, were always receiving renewed opportunities of exertion; thus his eloquence

Alting. quence and learning obtained full ſcope in the ſynod of Dort, to which he had been deputed by the Palatinate, along with two other divines.

It was but reaſonable for Alting to expect high preferment and high advantages from the avowed patronage of the elector; but in this he was greatly diſappointed, and he had only to participate in his misfortunes. In 1622, Count Tilly took the city of Heidelberg, and devoted it to plunder. In order to eſcape the fury of the ſoldiers, Alting endeavoured to paſs by a back door into the chancellor's houſe, which was put under a ſtrong guard; but the officer who guarded the houſe, as he was entering ſaid to him, "With this battle-axe I have to-day killed ten men, and Alting, if I knew where to find him, ſhould be the eleventh: who are you?" Alting with a ſingular preſence of mind returned an evaſive anſwer, which ſaved his life. "I am (ſaid he) a teacher in the college of Wiſdom." The officer took him under his protection, but the Jeſuits unfortunately taking poſſeſſion of the houſe, the next day, left the generous officer no time at his departure to take care of the teacher of the college of Wiſdom. Alting evaded the hands of the Jeſuits, by hiding himſelf in a garret, and a cook of the electoral court ſupplied him with food, who happened to be employed by Count Tilly in the kitchen occupied by him in the chancellor's houſe. In this perilous ſituation he remained until an opportunity offered of making his eſcape to Heilbron, whither his family had been conducted before.

But eccleſiaſtical intolerance haraſſed Alting, as much as he was formerly endangered by military hoſtility. With the permiſſion of the duke of Wirtemberg he retired for a few months to Schorndorf after the deſolation of the Palatinate by the victorious forces of Count Tilly. It was reaſonable to expect that a welcome and hoſpitable reception might have been given, among Proteſtants, to one who had juſt eſcaped the the flames of a Popiſh war. But the doctrine of mutual forbearance and candour ſeems to have been little attended to by the Proteſtants at this period, whatever was their progreſs in the knowledge of the other doctrines of Chriſtianity. The palatinate being in the vicinity of the duchy of Wirtemberg, the profeſſors of Tubingen and Heidelberg frequently attacked each other in polemic writings and theological diſputations. The natural conſequence was, that a ſettled jealouſy and enmity exiſted between the two ſchools and their reſpective vicinities. The injuries which Alting had ſuffered from the common enemy were not ſufficient to ſecure him a friendly reception among the Lutheran miniſters of Schorndorf, who were involved in theſe feuds, and therefore murmured at the permiſſion which the duke had given to a profeſſor of Heidelberg to reſide there. The miſchievous effects of religious diſſenſions have been univerſally felt.

In 1623, Alting retired with his family to Embden, and afterwards followed to the Hague his late pupil, now king of Bohemia. Such was the unfeigned attachment of his maſter to him, that he ſtill retained him as a preceptor to his eldeſt ſon; and prevented him from accepting the charge of the church at Embden, and likewiſe of a profeſſorſhip at the univerſity of Franeker. In 1627 his importunity prevailed upon his patron, and he obtained leave to remove to Groningen, and there aſcended the divinity chair; and continued to lecture with increaſing reputation until the day of his death. The ardent deſire and repeated endeavours of ſeveral univerſities to appropriate to themſelves the honour and benefit of his ſervices, is the moſt unequivocal proof of the general eſteem in which his character was held. The ſtates of Groningen poſitively refuſed to give their conſent to his removal, when the univerſity of Leyden ſolicited him to come and labour among them. But ſome time after, the proſpect of extenſive uſefulneſs in re-eſtabliſhing the univerſity of Heidelberg, and reſtoring the churches of the Palatinate, determined him to accept the office of profeſſor of divinity and eccleſiaſtical ſenator, preſented to him by Prince Lewis Philip. In the year 1634, amidſt numerous hardſhips, to which the exiſting war expoſed him, he ſet out for Heidelberg, and purſued his journey as far as Francfort; when the battle of Norlingen, in which the imperialiſts were victorious, rendered his farther progreſs impracticable, and therefore with great difficulty he returned to Groningen. Alting.

Domeſtic affection and perſonal ſufferings embittered the remaining years of this excellent man's life. Deprived of his eldeſt daughter by death, ſuch was his great affection for her that it brought on a ſettled melancholy, attended with a bodily diſeaſe which was with great difficulty removed; but after an interval of four years a ſettled and irrecoverable melancholy ſeized him, in conſequence of the loſs of an amiable and beloved wife, which, together with the return of his bodily diſeaſe, in a few months put a period to his uſeful life in the year 1644.

Alting was a man of eminent talents and extenſive learning, poſſeſſed of amiable diſpoſitions, which induced him to be more ſolicitous to ſerve the public than to benefit himſelf. The amiable character and extenſive learning of Alting, cannot fail deeply to intereſt every reader, in conſequence of his misfortunes. He was averſe to quarrels and diſputes about trifles, although no friend to the innovations introduced at this period by the Socinians. According to his own judgment, adhering to the plain doctrine of Scripture, he was equally deſirous to avoid fanatical ſcrupuloſity and ſophiſtical ſubtility. The productions of his pen are: *Notæ in Decadem Problematum, Johannis Behm*, Heidelbergæ, 1618; "Notes on a Decad of Jacob Behmen's Problems." *Loci Communes;* "Common places." *Problemata;* "Problems." *Explicatio Catacheſeos Palatinat.;* "Explanation of the Palatine Catechiſm." *Exegeſis Auguſtanæ Confeſſionis*, &c. Amſt. 1647; "Commentary on the Auguſtan Confeſſion." *Methodus Theologiæ Didacticæ et Catacheticæ*, Amſt. 1650; "A method of Didactic and Catechetic Theology." The *Medulla Hiſtoriæ Prophanæ*, "Marrow of Profane Hiſtory," publiſhed under the name of Paræus, was written by Alting. *(Gen. Biog.)*

Alting, *James*, ſon of Henry Alting, was born at Heidelberg in 1618. After the uſual courſe of grammatical ſtudies he became a ſtudent, and ſoon after profeſſor of divinity in the univerſity of Groningen. The Oriental languages were his favourite ſtudies at an early period of his life; and in 1638 he put himſelf under the tuition of a Jewiſh rabbi at Embden. Determining to take up his reſidence in England, he arrived there in 1640, and was admitted to clerical orders by Doctor Prideaux biſhop of Worceſter. By an an offer of the Hebrew professorship in the university of Groningen, he was soon induced to alter his plan of life, and consequently again returned to Germany in 1643. His active assiduity in these languages, and his knowledge in other sciences, procured him universal esteem, and great reputation as a scholar. About this time he received many academic honours; he was admitted doctor of philosophy, academic preacher, and at last, in conjunction with a colleague, Samuel des Marets, was chosen professor of divinity. These professors followed different methods of teaching, and adopted different systems. Des Marets was an admirer and follower of the subtilities of the scholastics; and by the ingenuity with which he pursued the scholastic plan of instruction had acquired great reputation and considerable influence. Alting spent his time in the study of the Scriptures, and in the pursuit of Rabbinical learning; and he delivered a course of lectures on divinity, which gained him great popularity. As it might naturally be expected, a mutual jealousy arose between the two professors; and their respective partisans in the university carried their animosity to an undue height. Established opinion, and the weight of authority, marshalled on the side of Des Marets. By the permission of the curators of the university he appeared as public accuser of Alting, and produced a long list of erroneous propositions to the divines of Leyden for their opinion. The judgment of the divines upon the dispute shows a great degree of moderation and good sense: they pronounced Alting innocent of heresy, but imprudently fond of innovation; and they declared Des Marets deficient in modesty and candour. If the superiors had not prohibited the farther discussion of these subjects in the consistories, classes, and synods, they would have occasioned as much mischief as they had excited general attention. Such was the protection given to Alting, that whenever any of the order of ecclesiastics proposed any further measures against him, they were immediately rejected by the civil power; nay, the penalty of deprivation was decreed against those clergy who should revive the *Maresio-Altingian* controversy. Whatever might be the advantages resulting to Alting from this protection, the magistrates certainly did wrong in proceeding so far in prohibiting a free discussion from the press, either for or against the judgments of the divines of Leyden. Although a kind of reconciliation was attempted by their common friends while Des Marets lay upon his death-bed, yet the breach between Des Marets and Alting was never perfectly healed. Dr Alting died of a fever in 1679. The fondness which he shewed for Rabbinical learning gave birth to the general report, that he was inclined to become a Jew. His opinions which seem to have excited more general attention than they deserve, may be seen at large in his writings, which were collected a few years after his death, and published in five volumes folio by his cousin Menso Alting, who wrote a good description of the Low Countries, under the title of *Notitia Germaniæ Inferioris*. (*Gen. Biog.*)

ALTITUDE, accessible and inaccessible. See Geometry.

The method of taking considerable terrestrial altitudes, of which those of mountains are the greatest, by means of the barometer, is very easy and expeditious.

Is is done by observing, on the top of the mountain, how much the mercury has fallen below what it was at the foot of the mountain. See Barometer.

Altitude of the Eye, in *Perspective*, is a right line let fall from the eye, perpendicular to the geometrical plane.

Altitude, in *Astronomy*, is the distance of a star, or other point, in the mundane sphere, from the horizon.

This altitude may be either *true* or *apparent*. If it be taken from the rational or real horizon, the altitude is said to be true or real; if from the apparent or sensible horizon, the altitude is apparent. Or rather, the apparent altitude is such as it appears to our observation; and the *true* is that from which the refraction has been subtracted.

The true altitudes of the sun, fixed stars, and planets, differ but very little from their apparent altitudes; because of their great distance from the centre of the earth, and the smallness of the earth's semidiameter, when compared thereto. But the difference between the true and apparent altitude of the moon is about 52. This subject is further explained under Astronomy.

Altitude Instrument, or *Equal Altitude Instrument*, is that used to observe a celestial object when it has the same altitude on the east and west sides of the meridian. See Astronomy.

ALTKIRK, a town of France, in the department of the Upper Rhine, situated on the river Ill, in N. Lat. 47. 40. E. Long. 7. 15.

ALTMORE, a town of Ireland, in the county of Tyrone, and province of Ulster, situated in N. Lat. 54. 34. W. Long. 7. 2.

ALTON, a town in Hampshire, seated on the river Wey; W. Long. 0. 46. N. Lat. 51. 5. It is governed by a constable; and consists of about 300 houses, indifferently built, chiefly laid out in one pretty broad street. It has one church, a Presbyterian, and a Quaker's meeting, a famous free school, a large manufacture of plain and figured baragons, ribbed druggets, and serges de Nismes; and round the town is a large plantation of hops.

Alton, or Avelton, a village in Staffordshire, five miles north of Utoxeter. There are the ruins of a castle here, which some would have to be built before the Norman conquest; but Dr Plott is pretty certain that it was erected by Theobald de Verdun, in the beginning of the reign of Edward II. A great part of the walls are still standing, but they are in a very ruinous condition.

ALTO *et Basso*, or *in Alto et in Basso*, in *Law*, signifies the absolute reference of all differences, small and great, high and low, to some arbitrator or indifferent person. *Pateat universis per præsentes, quod Willielmus Tylar de Yetton, et Thomas Gower de Almestre, posuerunt se in* Alto *et in* Basso, *in arbitrio quatuor hominum; viz. de quadam querela pendente inter eos in curia. Nos et terram nostram* altè *et* bassè *ipsius domini Regis suppofuimus voluntati.*

Alto-Relievo. See Relievo.

Alto-Repieno, in *Music*, the tenor of the great chorus, which sings and plays only now and then in some particular places.

ALTORF, a town of the circle of Franconia, in Germany.

Alt-ranstadt ‖ Alva.

Germany. It has a botanical garden, with a great variety of plants, an anatomical theatre, and a handsome library. It is subject to the house of Brandenburg; and is seated on the confines of Bavaria, 15 miles from Nuremberg. E. Long. 11. 7. N. Lat. 49. 25.

ALT-RANSTADT, a town in Saxony, famous for the treaty between Charles XII. king of Sweden and Augustus elector of Saxony, in 1706, wherein the latter resigned the kingdom of Poland.

ALTRINGHAM, a town of Cheshire in England, upon the borders of Lancashire, seven miles from Manchester. W. Long. 1. 30. N. Lat. 53. 25.

ALTZEG, a town of Germany in the Lower Palatinate, the capital of a territory of the same name, with an old castle. W. Long. 7, 25. N. Lat. 49. 44.

ALVA DE TORMES, a considerable town in Spain, in the kingdom of Leon, and territory of Salamanca, with a very handsome castle. It is seated on the north bank of the river Tormes. W. Long. 6. 1. N. Lat. 41. 0.

ALVA, *Ferdinand Alvarez of Toledo, duke of*, was born in 1508, and descended from one of the most illustrious families of Spain. His grandfather, Frederick de Toledo, was his preceptor in the military and political arts, and he displayed his valour at the battle of Pavia and at the siege of Tunis. The ambitious Charles V. selected Alva as a proper instrument for conducting his military enterprises, and he made him his general in 1538; and, after several operations, in which he both displayed his valour and military knowledge, in 1542 he successfully defended Perpignan against the dauphin of France.

In 1546, Alva was made general in chief of the army which marched against the German Protestants, who were marshalled under the banners of the elector of Saxony. Francis, the king of France, died at Rambouillet, and by his death a considerable change was made in the state of Europe. Instantly, therefore, Charles began his march from Egra on the borders of Bohemia, and entered the southern frontier of Saxony, and attacked Altorf upon the Elster. Incessantly pushing forward, he arrived the evening of the 23d of April on the banks of the Elbe, opposite to Muhlberg. The river, at that place, was three hundred paces in breadth, about four feet in depth; its current rapid; and the bank possessed by the Saxons was higher than that which he occupied. In opposition to the opinion of the duke of Alva and his other officers, Charles, with undaunted courage, and with inexpressible difficulties, led his army through the river, and engaged the Saxons. The elector displayed great personal courage and military knowledge, but having received a wound in the face, he at last surrendered himself prisoner. When he approached the emperor, he said, "The fortune of war has made me your prisoner, most gracious emperor, and I hope to be treated"—— Here Charles harshly interrupted him, "And am I then at last acknowledged to be emperor; Charles of Ghent was the only title you lately allowed me. You shall be treated as you deserve." The elector made no reply; but, with an unaltered countenance, which discovered neither astonishment nor dejection, accompanied the Spanish soldiers appointed to guard him. The emperor proceeded towards Wittemberg, whither the remains of the Saxon army had fled, carrying along with him the captive prince, as a spectacle of consternation and amazement to his own subjects. But when he approached the town, he found it defended by the vigorous efforts of the elector's wife, along with the inhabitants. He summoned Sibylla once and a second time to open the gates, informing her, that if she persisted in her obstinacy, the elector should answer for it with his head. Accordingly he brought his prisoner to an immediate trial. The proceedings against him were as irregular as the stratagem was barbarous. Instead of consulting the states of the empire, or remitting the cause to any court, which, according to the German constitution, might have legally taken cognizance of the elector's crime, he subjected the greatest prince in the empire to the jurisdiction of a court martial. The emperor selected the unrelenting duke of Alva as a proper instrument to carry into effect any measure of violence and oppression, and therefore made him president of that court, composed of Spanish and Italian officers. Moved more by the entreaties of his wife than by a sense of his own danger, the elector submitted to all the rigorous and unjust measures that were proposed in order to save his life; but when it was added, that he should also renounce the Protestant faith and become a Roman Catholic, he refused to act in opposition to his conscience, and bravely fell a sacrifice to the cause of truth.

In 1552, Alva was intrusted with the command of the army intended to invade France, and was constrained by the opinion and authority of the emperor to lay siege to Mentz, in opposition to his own military knowledge; but notwithstanding all his valour and abilities, the duke of Guise successfully defended the place. In consequence of the success of the French arms in Piedmont, he was made commander in chief of all the emperor's forces in Italy, and at the same time invested with unlimited power. Success did not, however, attend his first attempts, and after several unfortunate attacks, he was obliged to retire into winter quarters. The next year he was sent into the pope's territories, and, had he not been restrained by his master, he would have taken possession of all his fortified places, and deterred Henry from entering into any new connexion with him, and have thereby prevented the renewal of the war. Philip was strongly inclined to peace, but Alva was inclined to severe measures: he however yielded to the instructions of his master, until being deluded, and sometimes haughtily answered, he at length sent Pino de Loffredo with a letter to the college of cardinals, and another to Paul, in which, after enumerating the various injuries which his master had received, and renewing his former offers of peace and friendship, he concluded with protesting that, if his offers were again rejected, the pope should be chargeable with all the calamities that might follow. The pope threw Loffredo into prison; and, had not the college of cardinals interposed, he would have even put him to death; and on account of Philip's failing to pay tribute for Naples, he deprived him of the sovereignty of that kingdom. This violent conduct of Paul gave great offence throughout all Europe, and greatly lessened his influence in Italy; but Philip, though a young, ambitious, powerful monarch, and of a temper of mind impatient of injuries and affronts, moved

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moved with a religious veneration, discovered an amazing reluctance against proceeding to extremities. After much time spent in negotiation, Philip was at last forced to give orders for Alva to take the field. He cheerfully obeyed, and began his march in the beginning of September 1556, with a well disciplined army, which reducing several towns in the Campagna di Roma, he pursued his conquests to the very gates of Rome. The circumstances, however, in which Alva found his army, induced him to make a truce of 40 days, and, after several negotiations, he yielded to peace. One of its terms was, that the duke of Alva should in person ask forgiveness of the haughty pontiff whom he had conquered. Proud as the duke was by nature, and accustomed to treat with persons of the highest dignity, yet such was the superstitious veneration then entertained for the papal character, that he confessed his voice failed him at the interview, and his presence of mind forsook him. Not long after this, he was sent at the head of a splendid embassy to Paris, to espouse, in the name of his master, Elizabeth, daughter of Henry king of France.

Philip II. his new master, being strongly devoted to the Roman see, and determined to reclaim rebels to his government, and dissenters from his faith, by the most unrelenting severity and unbounded cruelty, he pitched upon Alva as the fittest person to carry this system into practice: with this design, therefore, he was sent into the Low Countries in 1567. Having received his orders, armed with such power as left only the shadow of authority to the natural governor, and provided with 10,000 veterans, he marched towards that devoted country. When he arrived, he soon shewed how much he merited the confidence which his master reposed in him, and instantly erected a bloody tribunal, to try all persons who had been engaged in the late commotions which the civil and the religious tyranny of Philip had excited. The depraved enormities of the mind of Alva raged with unexampled violence. He imprisoned the counts Egmont and Horn, the two popular leaders of the Protestants, and soon brought them to an unjust trial, and condemned them to death. In a little time he totally annihilated every privilege of the people, and with uncontrolled fury and cruelty, put multitudes of them to death. Beholding herself deprived of all authority, and her subjects devoted to destruction, the duchess of Parma resigned her office, disdaining to hold the nominal, while the actual reins of power were in the hands of Alva. This event increased the general tide of wretchedness, and every place was filled with scenes of horror and dismay. Unable for the present to administer the least aid, the prince of Orange saved his life by flight. This noble prince suddenly collected an army in Germany, and returned to the relief of his countrymen; and at the same time Prince Lewis, his brother, marched with an army into Friesland. Although success at first attended Lewis, yet the activity and experience of Alva prevailed, and he was totally defeated. The prince of Orange proved a more formidable foe; and it gave exertion to the united talents of Alva, and his son Frederick of Toledo, to prevent the prince from making a descent upon the Netherlands. But notwithstanding all the address and military skill of the prince of Orange, this was effected; and the glory remained to Alva to baffle that great leader, and to compel him, after great loss of men, to disband the remainder of his army. Now the cruelty of Alva had unrestrained vent. Instantly the executioner was employed in removing all those friends of freedom whom the sword had spared. Uncontrolled, the base and unrelenting heart of Alva began to reduce all the provinces to utter slavery, and to extirpate Protestantism in that country. In most of the considerable towns, Alva built citadels. He erected a statue of himself, which was no less a monument of his vanity than his tyranny, in the city of Antwerp: he was figured trampling on the necks of two smaller statues, representing the two estates of the Low Countries. By his unusual and arbitrary requisition of new supplies from the states, he greatly aggravated this haughty insult. The human mind displays unusual vigour when rendered desperate by oppression. The exiles from the Low Countries, roused to action, fitted out a kind of piratical fleet, and, after strengthening themselves by successful depredations, ventured upon the bold exploit of seizing the town of Briel. Thus, unintended by him, the cruelty of Alva was the instrument of the future independence of the seven Dutch provinces. The fleet of the exiles having met the Spanish fleet, totally defeated it, and reduced North Holland and Mons; and numbers of cities hastened to throw off the yoke; while the states-general assembling at Dordrecht, openly declared against Alva's government, and marshalled under the banners of the prince of Orange. This situation of affairs opened the eyes of Alva to behold the instability of a power founded on terror and oppression; he therefore began in vain to use more lenient measures. He prepared, however, with vigour to oppose the gathering storm, and afterwards recovered Mons, Mechlin, and Zutphen, under the conduct of his son Frederick, where his soldiers more than retaliated upon the prince of Orange. With the exception of Zealand and Holland, he regained all the provinces; and at last his son stormed Waerden, and, massacring its inhabitants with the most savage cruelty, he then proceeded to invest the city of Haerlem. Fully convinced of the miseries that waited their surrender, this city stood an obstinate siege; and nothing less than the inflexible and persevering spirit of Alva could have opposed difficulties almost insurmountable. Despairing of success, Frederick was at one time disposed to raise the siege, but the stern reproaches of his father urged him on; and at length the inhabitants, overcome with fatigue and resistance, surrendered. The victorious Frederick gave tolerable conditions to the town; but his cruel father arriving on the third day after the surrender, sacrificed numerous victims, who had been led to expect mercy, and satiated his vengeance to the full. Their next attack was upon Alkmaar; but the spirit of desperate resistance was raised to such a height in the breasts of the Hollanders, that the Spanish veterans were repulsed with great loss, and Frederick constrained reluctantly to retire. Alva now resolved to try his fortune by sea, and with great labour and expence fitted out a powerful fleet, and proceeded to attack the Zealanders, but was entirely defeated, and the commander taken prisoner. About the same period, the prince of Orange proceeded to attack the town of Gertruydenburg. Alva's feeble state

Alva.

ſtate of health and continued diſaſters induced him to ſolicit his recal from the government of the Low Countries; a meaſure which, in all probability, was not diſpleaſing to Philip, who was now reſolved to make trial of a milder adminiſtration. In December 1573, that devoted country was freed from the preſence and oppreſſions of the duke of Alva, who, accompanied by his ſon, returning home, gave out the inglorious boaſt, that he had, during the courſe of ſix years, beſides the multitudes deſtroyed in battle and maſſacred after victory, conſigned 18,000 perſons to the executioner. Requeſens, who ſucceeded him in the command, in his firſt act of adminiſtration, pulled down his inſolent effigies at Antwerp, ſo that nothing might remain of him in that much injured country but the remembrance of his injuſtice and cruelty.

Returning from this ſcene of oppreſſion and blood, he was treated for ſome time with great diſtinction by his maſter. Juſtice, however, ſoon overtook the crimes of Alva: for his ſon having debauched one of the king's attendants, under promiſe of marriage, he was committed to priſon; and being aided in his eſcape by his father, and married by him to a couſin of his own, this procured Alva's baniſhment from court, and confinement in the caſtle of Uzeda. He remained two years in this diſgraceful ſituation, until the ſucceſs of Don Antonio, in aſſuming the crown of Portugal, determined Philip to turn his eyes towards a perſon, in whoſe fidelity and abilities he could on this occaſion moſt confide. A ſecretary was inſtantly deſpatched to Alva, to make inquiries concerning the ſtate of his health, and whether or not it was ſufficiently vigorous to undertake the command of an army. The aged chief returned an anſwer full of loyal zeal, and was immediately appointed to the ſupreme command in Portugal. It is a ſingular fact, however, that the enlargement and elevation of Alva was not followed by forgiveneſs. It is a characteriſtic mark of the unrelenting temper of Philip, and, at the ſame time, a noble teſtimony to the honour and loyalty of Alva, that although placed in this important truſt, he did not procure his pardon. In 1581, Alva entered Portugal, defeated Antonio, drove him from the kingdom, and ſoon reduced the whole under the ſubjection of Philip. Entering Liſbon, he ſeized an immenſe treaſure; and with their accuſtomed violence and rapacity, he ſuffered his ſoldiers to ſack the ſuburbs and vicinity. It is reported, that Alva being requeſted to give an account of the money expended on that occaſion, he ſternly replied, "If the king aſks me for an account, I will make him a ſtatement of kingdoms preſerved or conquered, of ſignal victories, of ſucceſsful ſieges, and of ſixty years ſervice." Philip deemed it proper to make no farther inquiries. Alva, however, did not enjoy the honours and rewards of his laſt expedition, for in 1582, at the age of 74, he was removed by death to the impartial tribunal of heaven, to receive the juſt rewards of his iniquitous life.

The actions already enumerated give ſuch an ample idea of his character, that little more is neceſſary to complete it. In him a variety of extremes concentred. Some of the beſt qualities of a commander were blended with ſome of the worſt that ever exiſted in a man or in a general. The Spaniſh ſeverity, little tempered by the ſpirit of generoſity, appeared in all its horrible deformity in Alva. A ſtrict impartial diſcipline was his greateſt military virtue, and vanity was his greateſt weakneſs. In conſequence of this ſtrict diſcipline, he ſometimes puniſhed the unlicenſed barbarities of his ſoldiers; and there is an inſtance recorded, that when his favourite ſon Frederick, thinking he could attack the prince of Orange with advantage, ſent a requeſt to his father for permiſſion, he received a ſtern reprimand, for preſuming to exerciſe his judgment on a point already determined by his ſuperior, with a threatening in caſe of repetition. (*Gen. Biog.*)

Alvah, Alvares.

ALVAH, the wood wherewith Moſes ſweetened the waters of Marah, Exod. ch. xv. ver. 25.—The name of this wood is not found in Scripture; but the Mahometans give it that of *alvah*, and pretend to trace its hiſtory from the patriarchs before the flood. Joſephus on the contrary, ſays, that Moſes uſed the wood which he found next lying before him.

ALVARES DE LUNA, treaſurer, and a great favourite of John II. king of Caſtile, was famous for the prodigious aſcendency he gained over this prince, and for the puniſhment which at length overtook him. He was a natural ſon of Don Alvaro de Luna, lord of Canete in Arragon, and of a woman of infamous character. He was born in 1388, and named Peter; but Pope Benedict XIII. who was charmed with his wit though yet a child, changed Peter to Alvares. He was introduced to court in 1408, and made a gentleman of the bedchamber to King John, with whom he grew into the higheſt favour. In 1427 he was obliged to retire: the courtiers exerted all their endeavours to ruin him: they complained, that a man of no military ſkill, of no virtues whatever, ſhould by mere artifice and diſſimulation, be advanced to the higheſt authority; and they could not bear, that by the aſſiſtance of a few upſtart men, whom he had raiſed and fixed to his intereſt, he ſhould reign as abſolutely as if he were king.

They prevailed againſt him, and Alvares was baniſhed from court a year and a half: but this was the greateſt affliction imaginable to the king; who ſhowed all marks of diſtreſs the moment he was removed from his preſence, and now thought and ſpoke of nothing but Alvares. He was therefore recalled; and, being inveſted with his uſual authority, revenged himſelf ſeverely upon his enemies, by perſuading the king to baniſh them. Of the 45 years he ſpent at court, he enjoyed for 30 of them ſo entire an aſcendency over the king, that nothing could be done without his expreſs orders: nay, it is related by Mariana, that the king could not change an officer or ſervant, or even his clothes or diet, without the approbation of Alvares. In ſhort he wanted nothing to complete his grandeur but the name of king: he had all the places in the kingdom at his diſpoſal; he was maſter of the treaſury, and by bounties had ſo gained the hearts of the ſubjects, that the king, though his eyes were now opened, and his affections ſufficiently turned againſt him, durſt not complain.

But the day of reckoning was approaching, and at length he was ſeized; yet not directly, openly, and violently, but with ſome of that management which upon a ſimilar occaſion was formerly employed by Tiberius againſt Sejanus. During his confinement, he made

 ſeveral

several attempts to speak to the king in person; but not being able to effect this, he sent the following letter, from which, as well as from the rest of Alvares's history, all court favourites may draw abundant matter for edification and instruction. "Sir, It is five "and forty years since I was admitted into your service. I do not complain of the rewards I have "received: they were greater than my merits or expectation, as I shall not deny. There was but one "thing wanting to complete my happiness; and that "was, to have fixed proper limits in time to this great "fortune of mine. While, instead of choosing retirement, after the example of the greatest men, I still "continued in the employment, which I thought not "only my duty, but necessary for your interest, I fell "into this misfortune. It is very hard that I should "be deprived of liberty, when I have risked life and "fortune more than once to restore it to you. Grief "prevents me from saying more. I know that the "Deity is provoked against me by my sins; but it will "be sufficient for me, if his anger is appeased by the "calamities I now suffer. I can no longer bear that "prodigious mass of riches, which it was wrong in "me to have heaped together. I should willingly "resign them, but that every thing I have is in your "power; and I am denied the opportunity of showing "mankind, that you have raised a person to the height "of greatness, who can contemn wealth as well as procure it, and give it back to him from whom he received it. But I desire you in the strongest terms, "that, as I was obliged, by the lowness of the treasury, to raise 10,000 or 12,000 crowns by methods "I ought not to have taken, you will restore them to "the persons from whom they were extorted. If you "will not grant this on account of the services I have "done, yet I think it necessary to be done from the "reason of the thing."

This letter, however, produced no effect in his favour: Alvares was tried, and condemned to lose his head. After condemnation, he was removed to Valladolid; and having confessed himself, and received the sacrament, he was carried upon a mule to the market-place, in the middle of which a large scaffold was erected. Mounting the scaffold, he paid reverence to the cross, and presently gave his hat and signet to his page, saying, "These are the last gifts you will ever receive from me." He then submitted himself to the axe with the utmost intrepidity.

ALVAREZ, Francis, a Portuguese priest, and almoner to Emanuel, king of Portugal, flourished about the beginning of the 16th century. He was sent ambassador from Portugal to David prince of Abyssinia; and after a residence of six years in that country, returned with letters of friendship from David to Juan, who had succeeded Emanuel, and of submission to Pope Clement VII. At Bologna, in the year 1523, he gave a narrative of his expedition to the pope, in the presence of the emperor Charles V. In the year 1540, he published the relation of his journey in one volume folio, in the Portuguese language. He gives a plain and accurate description of this empire; and we are indebted to him for the first of the kind that ever published. This work was translated into Latin, under the title of *De Fide, Regione, Moribus Ethiopum*, by Damien Goez, a Portuguese gentleman; and it has often been reprinted and translated into other languages. The information of Alvarez is not, however, to be received with implicit credit, because he does not always speak from his own observation, and he frequently exaggerates. (*Dict. Hist.*)

ALUDELS, in the older and more complicated chemical apparatus, were earthen pots without bottoms, inserted into each other, and used in sublimations.

ALVEARIUM, in *Anatomy*, the bottom of the *concha*, or hollow of the outer ear.

Alvearium also signifies a bee-hive. The word is formed of *alveus*, "a channel or cavity;" in allusion to the *alveoli* or cells in bee-hives.

Some of the ancients use also the word *alvearium* for a bee-house, more usually called among us *apiary*.

Alvearium is sometimes also used figuratively, to denote a collection; in which sense, *alvearium* amounts to much the same with what we otherwise called *thesaurus*, *cornucopia*, or the like. Vinc. Boreus has published an alvearium of law.

ALVEOLUS, in *Natural History*, the name of the waxen cells in bee-hives. Also the name of a sea fossil of a conic figure, composed of a number of cells like bee-hives, joined into each other with a pipe of communication.

Alveolus, in *Anatomy*, the sockets in the jaws wherein the teeth are fixed. Some writers speak of teeth growing without alveoli. Pliny mentions a person who had a tooth in his palate. Eustachius relates, that he saw a man who at 60 had a tooth growing out of the middle of his fauces. Holler gives an instance of a person whose teeth were of a piece with his jaws, without any insertion into alveoli.

ALVIANO, Bartholomew, a Venetian general, flourished in the beginning of the 16th century. His talents were well calculated for the conduct of military affairs, and in an early part of his life, raised him to great reputation. In the year 1508, he gained such signal victories over the emperor Maximilian, that he was decreed triumphal honours by the republic. During the famous league of Venice, he was second in command along with Count Pitigliano. It was, however, unfavourable to the cause in which they had engaged, that the tempers of the two commanders were very different. The commander in chief was hesitating and cautious; the other was bold and intrepid. Alviano commanded the rear-guard at the famous battle of Aignadel, and after displaying the greatest exertions of valour, was wounded, overpowered, and at last taken prisoner. An increasing tribute was paid to the military talents of Alviano; for after the Venetians had become the allies of France, he was intrusted with the command of their army. When the emperor attacked Padua, he defended it against him, and displayed numerous acts of valour in repulsing the imperial troops. But the current of human life runs unequally smooth on its attendance upon any character; for he lost the great battle of La Motte, in which, however, his exertions were so conspicuous, that the senate gave him the most honourable assurance of the continuance of their esteem. Fortune, however, soon became propitious to this great man, and he defeated the enemy in Friuli. In the desperate battle of Marignano, he afforded such timely aid to Francis I. that it greatly contributed to his success. But the most vigorous

gorous constitution must one day yield to the force of constant exertions, and the most incessant fatigue; he had incurred such hardships in superintending the works at the siege of Brescia, that he was seized with a fever, of which he died at the advanced age of sixty. His character stands high in the annals of military fame. By a strict observance of discipline, and a profuse liberality to his soldiers, he secured their esteem. As an unequivocal proof of this, they kept his body unburied twenty-five days, carrying it about with them during their marches, with all funeral pomp. His loss was deeply regretted by the state, and, as a proof thereof, his body was buried at the public charge, his unprovided family was supported by a liberal pension, and his daughters were portioned by the state. *(Gen. Biog.)*

ALUM, in *Chemistry*, a clear and transparent saline matter, usually sold in large masses, of a very austere and astringent taste, useful in medicine and in various arts.

Most of the alum to be met with is artificially prepared by the methods related in their proper place under the article CHEMISTRY, or by others similar to them: though sometimes a small quantity is produced naturally. This native alum is mixed with heterogeneous matters, or effloresces in various forms upon the ores during calcination. It rarely occurs in a crystallized state, though thus it is said to be met with in Egypt, Sardinia, Spain, Bohemia, and other places. It is also found in waters impregnated with fixed air, but very seldom in fountains or hot medicated waters.

There are several kinds of alum to be met with; but these differ from one another only in being mixed with some salts which are not of the aluminous kinds. That called the Roman alum has been considered as preferable to any other. This is usually met with in small crystals, and has a reddish colour, most probably owing to a small quantity of calx of iron, which, however, does not in the least impair its qualities. The other kinds of alum contain a portion either of vitriolated tartar or sal ammoniac, according to the nature of the alkali used in its preparation. Mr Bergman informs us, that the vegetable alkali, if pure, does not hurt the alum, though it be added in the preparation; but that the volatile alkali, by adulterating it with a portion of vitriolic sal ammoniac, renders it unfit for some purposes. The alum, made by adding a portion of clay to the liquor at the beginning of the boiling, he considers as equal, if not superior, to Roman alum. He informs us also, that a kind of alum some time ago began to be manufactured at Brunswick, which was equal in quality to the Roman alum. On a chemical analysis of this alum he found it mixed with cobalt.

This salt is extremely useful in the art of dying; as by means of it a great number of colours are fixed and rendered permanent upon cloth, which otherwise would either not adhere in any degree, or only for a very short time. In what manner this is accomplished, we are very much ignorant; the conjectures and theories on this subject are related under the article DYING. It constitutes the basis of crayons, which generally consist of the earth of alum finely powdered and tinged for the purpose. In the preparation of Prussian blue, it prevents the basis of martial vitriol, which is soluble in acids, from being precipitated by the superfluous alkali employed in the preparation of that pigment; that is, the alkali which is not saturated by the colouring matter. As this basis adheres more strongly than the clay to the vitriolic acid, and would form a green by the mixture of its yellowness, the white earth of alum likewise according to its quantity, dilutes the darker colours, even black itself, and produces an infinite number of shades. It is also of use in the making of candles: for being mixed with the tallow, it gives it a hardness and consistence which it has not naturally. Wood sufficiently soaked in a solution of alum does not easily take fire; and the same is true of paper impregnated with it; which, for that reason, is very properly employed in preserving gunpowder, as it also excludes the moisture of the air. Paper impregnated with alum is useful in whitening silver, and silvering brass without heat. Alum is also of use in tanning, where it assists in restoring the cohesion of the skins almost entirely destroyed by the lime. Vintners fine down their wines, &c. with alum; fishers use it to dry cod fish with; and bakers have mixed it with the flour to make their bread compact and white: to this last use of it great objections have been made; but unjustly, for it is entirely innocent. It is now seldom used.

In medicine it is of considerable use as an astringent and tonic. It is reckoned particularly serviceable for restraining hemorrhages, and immoderate secretions from the blood; but less proper in intestinal fluxes. In violent hemorrhages, it may be given in doses of 15 or 20 grains, and repeated every hour or half hour till the bleeding abates: in other cases, smaller doses are more advisable; large ones being apt to nauseate the stomach, and occasion violent constipations of the bowels. It is used also externally, in astringent and repellent lotions and collyria. Burnt alum taken internally has been highly extolled in cases of colic. In such instances, when taken to the extent of a scruple for a dose, it has been said gently to move the belly, and give very great relief from the severe pain. Its officinal preparations are, for internal use, *pulvis stypticus*, and *aqua styptica;* for external applications, the *aqua aluminis*, and *coagulum aluminis* and *alumen ustum;* which last is no other than the alum dried by fire, or freed from the watery moisture, which, like other salts, it always retains in its crystalline form. By this loss of its water it becomes sharper, so as to act as a slight escharotic; and it is chiefly with this intention that it is employed in medicine, being very rarely taken internally. For these preparations, see PHARMACY.

ALUM Mines are said to have been first found in Italy in the year 1460; and in 1506 King Henry VII. made a monopolizing grant of this commodity to Augustine Chigi, a merchant of Sienna. In the year 1608, the manufacture of alum was first invented, and successively practised in England, meeting with great encouragement in Yorkshire, where it was first made, from Lord Sheffield, and the other gentlemen of that county. King James I. by advice of his ministry, assumed the monopoly of it to himself, and therefore prohibited the importation of foreign alum; and in 1625 the importation of it was further prohibited by the proclamation of Charles I.

ALUM Works, places where alum is prepared, and manufactured in quantities for sale. They differ from alum

alum mines, as in the former an artificial alum, and in the latter natural alum, is produced.

ALUNTIUM, Alontium, in *Ancient Geography*, a town in the north of Sicily, situated on a steep eminence, at the mouth of the Chydas; said to be as old as the war of Troy. It is now in ruins; and from these has arisen the hamlet *St Philadelfo*, in the Val di Demona. The inhabitants were called *Haluntini*.

ALVUS, in *Anatomy*, a term used for the belly in general, but more frequently applied to the bowels.

ALWAIDII, a sect of Mahometans who believe all great crimes to be unpardonable.—The Alwaidii stand in opposition to the Morgii. They attribute less efficacy to the true belief in the salvation of men than the rest of the Mussulmans.

ALYPIUS of Antioch, a geographer of the fourth century. He was sent deputy-governor by the emperor Julian into Britain; and after he remained in this situation for some time, he received orders from the emperor to rebuild the temple of Jerusalem. Ammianus Marcellinus, the Roman historian, informs us, that during the progress of the work, whilst it was proceeding with great rapidity, huge balls of fire issued forth in the vicinity of the foundations, which interrupted the men at their labour, and even sometimes consumed them with its violence. Thus the place being rendered inaccessible, they were reluctantly constrained to desist from their undertaking. Different sentiments have been entertained of this phenomenon; but the reader may consult, for his own satisfaction, what has been written by Lardner and Gibbon concerning it. In the evening of his life, after he had retired from the service of the public, Alypius, in conjunction with several other persons, was formally accused of the crime of practising magic. In consequence of which, he was punished with banishment and confiscation of property, and Hierocles his son was condemned to capital punishment. Ammianus Marcellinus, whilst he mentions that the crime for which they suffered, was that of administering poison to others, at the same time freely delivers his opinion, that they were the victims of the general injustice and oppression which reigned at that period, and extended their sway even to the most retired habitations. The emperor Julian himself honoured Alypius with his confidence, and speaks of him with great respect. "As to your conduct in public affairs (says the emperor), it gives me pleasure to observe the assiduity and humanity which appear in all your transactions; for so to temper lenity and moderation with firmness and fortitude, that the good may experience the benefit of the former, and the bad may be corrected by the latter, requires no small share of ability and virtue." Alypius composed a geographical work which is said to have gained the approbation of the emperor, but this work has shared the same fate as many other productions of antiquity. Some have ascribed the work which Godfrey published under the title of "A Description of the Old World;" printed in 4to, at Geneva, to Alypius; but since that author speaks of Britain, not merely from report, but his own observation; this, together with the testimony of some writers, leads to the conclusion, that this "Description" is an anonymous work, published in the reigns of Constantius and Constans. (*Gen. Biog.*)

Alypius, one of the seven Greek writers on music, which Meibomius has industriously collected and published, with a commentary and explanatory notes. The time in which he flourished cannot be precisely ascertained. He is said to have wrote before Euclid and Ptolemy; and Cassiodorus arranges his work, entitled "Introduction to Music," between that of Nicomachus and Gaudentius. In this work is to be found the most complete nomenclature of all the sounds of the different scales and modes of the ancient Greek music, which have escaped the wreck of time. So complex was the science of music in Greece at this period, that the characters used for sounds were 1620 in number. The twenty-four letters of the alphabet furnished these notes, sometimes in an entire, sometimes in a mutilated, and sometimes in an altered form; and numerous discriminations of these took place by means of the accents and varied positions of letters.

From the MS. of Joseph Scaliger, Meursius first published this tract in 1616; but according to the testimony of Fabricius, it is by no means correct. Extracts have been published from Alypius, by Kircher, in his Musurgia, 1650, alleging that he translated the whole into Latin; but this table of ancient musical notation is so inaccurate, which he has inserted from him, that Meibomius, who consulted not only the Greek MS. of Scaliger, but that of Belejanus, Barocus, Barberitti, and Selden, affirms, that he found in it more than 200 errors. The learned Meibomius, with incredible industry, decyphered those characters, which previous to his time were so much confounded, disfigured, and corrupted, either through the ignorance or inattention of the transcribers of ancient MSS. This advantage resulted to the science of music, chiefly by his commentaries on Greek musicians, and particularly on the works of Alypius.

Alypius of Tagasta, a Christian divine who flourished in the fourth century. In the year 388, he was baptized along with Augustine, and, in consequence of a similarity of dispositions and religious sentiments, they became strongly attached to each other. In quest of information and improvement, he took a journey into Palestine; and returning home, he soon acquired such general esteem, that he was appointed bishop of his native city. He had adopted in the early part of his life the opinions of the Manichees; but in consequence of farther information and matured experience, he became a powerful advocate for the Catholic faith. The Donatists flourished about this period, and arrogantly claimed the exclusive honour of being the true church; but he, along with his friend Augustine, united his exertions in opposing the tenets of that sect. In the council of Carthage in the year 403, the erudition and talents of Alypius, along with several other eminent divines, were unsuccessfully employed in endeavouring to reclaim them, and to bring them again into the bosom of the church. In 411 Alypius was one of the seven who held a friendly and theological conference with seven of the Donatist bishops. But all the eloquence and strength of argument made use of by these divines, although seconded by the penal decrees of the emperor Honorius, were unsuccessful in producing a recantation of their errors, or a peaceful union with their brethren. In support of the Catholic faith, Alypius appears to have vigorously exerted

erted his talents; and it is much to be regretted that the means he employed for that purpose were not at all times the most honourable; for in the violence of his zeal he went as deputy from the churches of Africa to the emperor Honorius, in order to obtain severe decrees against the sect of the Pelagians. Although Alypius failed in his attempts to reclaim the Donatists from error, yet he was successful with the emperor in obtaining penal decrees against the Pelagians; in consequence of which their ministers were banished, their churches demolished, and their assemblies discontinued. Alypius died about the year 430, and his dispositions appear to have participated more of the violence of zeal, than of the meekness of charity. (*Gen. Biog.*)

ALYSSUM, ALYSSON, or ALYSOIDES, *Madwort;* (from αλυσσω, *to be mad;* because it was believed to have the property of curing madness). See BOTANY *Index*.

ALYTARCHA, a priest of Antioch in Syria, who, in the games instituted in honour of the gods, presided over the officers who carried rods to clear away the crowd and keep order.

In the Olympic games, the alytarches had the same command, and obliged every person to preserve order and decency.

ALZIRA, a town of Spain, in the kingdom of Valencia, seated on the river Xucar. E. Long. 0. 20. N. Lat. 39. 10.

AMA, in *Ecclesiastical Writers*, denotes a vessel wherein wine, water, or the like, were held, for the service of the eucharist. In this sense the word is also written amula; sometimes also hama, and hamula.

AMA is sometimes also used for a wine measure, as a cask, pipe, or the like.

AMABYR, a barbarous custom which formerly prevailed in several parts of England and Wales, being a sum of money paid to the lord when a maid was married within his lordship. The word is old British, and signifies "the price of virginity."

AMACK. See AMAK.

AMADABAT, a corruption from AHMED ABAD, or *Ahmed's city* (so called from a king of that name); a large and populous city of Indostan, and the capital of the province of Guzerat. It is situated in E. Long. 72. 12. N. Lat. 23. 0. Amadabat was formerly called *Guzerat;* and by Shah Jehân nicknamed *Gherdabâd*, or "the habitation of dust," because it was much incommoded therewith. It was the seat of the Guzerat kings, as it is now of the Mogul governor. The city stands in a beautiful plain, and is watered by the little river Sabremetti, which, though not deep, in time of rains overflows the plains prodigiously. The walls are built with stone and brick, flanked at certain distances with great round towers and battlements. It has twelve gates; and, including the suburbs, is about four miles and a half long. The streets are wide. The *meydân shâh*, or king's square, is 700 paces long, and 400 broad, planted round with trees. On the west side is the castle, well walled with free stone, and as spacious as a little city; but its inward appearance is not conformable to its external magnificence. The caravansera is on the south of the square, and its chief ornament. Near the meydan also is the king's palace, whose apartments are richly ornamented; and in the midst of the city is the English factory, where they purchase fine chintz, callicoes, and other Indian merchandise. The place is so full of gardens stored with fruit trees, that from an eminence it looks like a wood. The Hindoos have here an hospital for sick beasts, and another for sick birds, which they take great care of. According to some late accounts, this city is little inferior to the best in Europe, and is thought to yield ten times as much revenue as Surat.

AMADAN, or HAMADAN, a town of Persia, between Taurus and Ispahan. E. Long. 47. 4. N. Lat. 35. 15. It is seated at the foot of a mountain, where there are a great many springs, which water the adjacent country. The extent of the city is very large; but there are a great many waste spots within it, as well as cultivated land. The houses are built of brick hardened in the sun, and have but a very indifferent aspect. There is but one tolerable street; and that is where stuffs, garments, and the like, are exposed to sale: it is straight, long, and wide; and the shops are very well furnished. The adjacent parts are fruitful in corn and rice, insomuch that the neighbouring provinces are supplied from hence. It is said to enjoy a very salubrious air; but the cold in winter is intense. The Armenians have a church in this town; but it is a very ill contrived structure. The Jews have a synagogue near a tomb, where they pretend Esther and Mordecai lie interred. To this place they come in pilgrimage from several parts of the Levant. About a league from Amadan, there is a mountain called *Nalbana*, which abounds with all sorts of curious herbs. In the spring, people flock to this mountain from all parts to recover their health, by sucking in the salutary effluvia with their breath.

Amadan is a very ancient city. It is said to have been destroyed by Nebuchadnezzar, and rebuilt by Darius, who brought hither all his riches. The kings of Persia frequently retired to this place on account of its delightful situation; for which reason it obtained the name of the *Royal City*. It was conquered by the caliph Othman, and narrowly escaped being destroyed by Jenghiz Khan in 1220. It had then strong walls and a good castle, which are now in ruins. Its present beauty consists in its gardens and springs.

AMADANAGER, a town in the hither peninsula of India, in the province of Decan. E. Long. 74. 15. N. Lat. 18. 10. It was taken by the Moguls in 1598, after a siege of six months; being at that time defended by a strong castle, situated on an eminence, and surrounded with deep ditches, into which several springs discharged their waters.

AMADEUS V. count of Savoy, arose to that dignity in thel year 1285. In him it appeared, that mental excellence can rise superior to riches or extent of territory; for although his dominions were by no means extensive, nor his riches great, yet, in consequence of his wisdom and success, he obtained the surname of *Great*. The cautious prudence of Amadeus, however, enabled him greatly to increase his territory by means of marriage, purchase, and donations. In this situation, with extended dominion, and distinguished for wisdom and prudence, he rose to such eminence among the European powers, that he was constituted their umpire to settle their differences; and in that station acquitted himself with much reputation and general

Amadeus. neral utility. But in his character valour and wiſdom were combined; for when the Turks attempted to retake the iſle of Rhodes from the knights of St John of Jeruſalem, he boldly defended it, and acquired great renown. A Malteſe croſs with the letters F. E. R. T. in future became the arms of Amadeus and his ſucceſſors, in memory of this ſignal victory. The explanation of this motto is ſaid to be *Fortitudo ejus Rhodum tenuit.*—"His valour kept Rhodes." For this important ſervice the grand maſter conferred on him the grant of a palace at Lyons. Andronicus the emperor of the eaſt had married his daughter; and in order to promote the views of his ſon-in-law, Amadeus took a journey to Avignon to perſuade Pope John XXII. to preach a cruſade in favour of Andronicus. In the year 1323 the famous Amadeus died at that place. Deep penetration, keen diſcernment, conſummate prudence, great valour, together with no ſmall portion of the religious ſuperſtition of his time, appear to have been the reigning features in his character. (*Mod. Univ. Hiſt.*)

Amadeus VIII. count of Savoy, in 1391, ſucceeded his father Amadeus VII. With the large ſum of 45000 florins of gold he purchaſed the country of Genevois from its laſt earl. Anxious to extend his territories, he purchaſed the city of Rumilli, upon the lake of Geneva, from the widow of the count of Genevois, and thus the houſe of Savoy became ſo illuſtrious that the emperor Sigiſmund erected Savoy into a duchy in the year 1426. Hiſtorians relate, that he aſſiſted John Paleologus againſt the duke of Milan, who endeavoured to wreſt from him the duchy of Montferrat. Deeply ſenſible of the ſervices which he had received, Paleologus not only reſigned to the duke, Chivas, Brandis, and ſeveral other eſtates, but ſubmitted to hold all the marquiſate of Montferrat as a fief from the houſe of Savoy. Theſe fortunate acquiſitions of territory were not yet limited; for upon the marriage of his daughter with Philip Maria, duke of Milan, he received Vercelli, and about the ſame time the count of Creſcentino ſubmitted to become his feodary. In his ambitious purſuit, he laid claim to the ſovereignty of the city of Geneva; but that claim, though enforced by the pope, was rejected by the citizens with diſdain, and the emperor Sigiſmund taking it under his protection, declared it an imperial city. After ſuch an extenſive acquiſition of dominion, and amaſſing ſuch ſums of money, he formed the ſingular ſcheme of abandoning his throne and family; and for that purpoſe retired to a religious houſe at a place called *Ripaille*. But although he reſigned the dukedom of Savoy to his eldeſt ſon Lewis, and made his youngeſt ſon Philip, count of Genevois; yet their honours were merely nominal, for he conſtrained them to live on a very ſcanty allowance, while he in his retirement received all the revenues, and collected ſuch ſums of money that he is ſaid to have purchaſed the papal honours. During the previous part of his life having adopted great ſanctity of manners, the motives for his retirement were generally reckoned religious; but what was the aſtoniſhment of mankind to behold the ſeat of his hermitage become the habitation of every rare delicacy, and of the moſt refined luxury. The local ſituation of the place was truly delightful, and was enriched with every thing that could afford gratification to the ſenſes; and his retinue conſiſted of ſome of his moſt intimate friends, along with 20 faithful ſervants, who were the guardians of his voluptuous ſecrets. Neither did he aſſume a religious habit, but wore purple robes, and upon his mantle was embroidered a golden croſs. His table groaned under the weight of luxurious dainties, and the moſt excellent muſic cheered the daily feaſt; in ſhort, ſuch was the voluptuouſneſs of that place, that in the French language the phraſe, *faire ripailles*, ſignifies to make exquiſite good cheer.

He inſtituted a ſecular knighthood in that place under the appellation of St Maurice. The brethren aſſumed the name of hermits, wore beards, and excluded women from their community; and in other reſpects compoſed the character of decent epicures.

When he obtained the papal dignity, and was crowned by the cardinal of Arles at Baſil, all Europe was filled with aſtoniſhment in conſequence of his elevation; for he had never entered into holy orders. But he had found means to remove every objection, the council confirmed his election, and with pretended reluctance he put on the pontifical ornaments, and was conſecrated in the church of St Maurice. It ſeemed good to Amadeus to aſſume the title of Felix V. As might naturally be expected in ſuch circumſtances, the papal dignity was ſeverely conteſted between him and Eugenius; and notwithſtanding all the importunities of the council, the emperor refuſed to acknowledge his elevation. This religious diſpute involved all Europe in contention. Hiſtorians relate that Germany remained neutral, and France, England, Italy, Spain, and Hungary, declared for Eugenius; but Arragon, Poland, and Bretagne recogniſed the council only; at the ſame time that Savoy, Switzerland, Baſil, Straſburg, Pomerania, and one of the duchies of Bavaria, recogniſed Felix. The emperor Frederick III. held a council at Frankfort, before which both the popes urged their reſpective rights by means of deputies. This attempt, however, to regain peace to Europe was unſucceſsful; therefore the emperor repaired to the vicinity of Baſil, and had a perſonal interview with Felix. The mind of Amadeus was now ſo confirmed in the enjoyment of pleaſure, that he had again returned to his favourite retreat; and after the fathers of the council had frequently ſolicited him in vain to reſide at Baſil, he prevailed upon them to remove to Lyons, which was near the ſeat of his pleaſures. During the conteſt, Eugenius had excommunicated Felix, the council, and ſeveral of the German princes, ſo that the whole church was then filled with confuſion and diſorder. The death of Eugenius, however, terminated the ſtruggle; for upon his death the cardinals at Rome elected Thomas de Sarzan, who aſſumed the name of Nicholas V. In this ſituation of affairs, Amadeus deemed it prudent to enter into a negotiation for the reſignation of his papal crown. In this tranſaction he diſplayed the profoundeſt policy and addreſs, which induced Nicholas to annul all that Eugenius had done to his diſhonour, or that of his aſſociates; to confirm the determination of the council of Baſil to appoint him perpetual apoſtolical legate in Savoy, Piedmont, and the other places of his own dominions, and even added to theſe the honour of being biſhop of Baſil, Lauſanne, Straſburg, Strafburg, and Conftance. Nor did his vanity forfake him even in this political tranfaction, for he provided that he fhould continue to wear the pontifical drefs unlefs in a very few particulars. In order to gratify the fame haughty difpofition, he ftipulated that he fhould not be obliged to go to Rome, to attend any general council; and that when he had occafion to approach the pope, he fhould rife to receive him, and inftead of kiffing his toe, he fhould be permitted to kifs his cheek. Amadeus retired to Laufanne, and died there at the age of 60, in the year 1451.

As the time in which he lived is fertile in memorable events, fo the character of Amadeus was one of the moft diftinguifhed of his time. The verfatility of his genius has led writers to differ in the delineation of his character. Some have reprefented him as a perfon of fingular fanctity of manners, and poffeffed of uncommon moderation and virtue; others have reprefented him as a confirmed bigot, and a violent enthufiaft; and a third clafs of authors have magnified his talents far above the general ftandard, and extolled him as one of the moft accomplifhed princes in Europe. His real character appears to be a compound of extravagancies, in which virtue, genius, caprice, and vanity were blended. (*Mod. Univ. Hift.*)

Amadeus IX. count of Savoy, fucceeded his father Lewis, in his dominion and honours. The prince who exerts his talents to promote the happinefs of his fubjects, is worthy of more fame than the prince who increafes the number of his fubjects by unjuft and unneceffary wars. In this view Amadeus IX. deferves a place in the annals of his nation. His bodily conftitution was weak, and he was afflicted with the falling-ficknefs, yet, in confequence of his piety, virtue, benevolence, and juftice, he was furnamed the *Happy*. The clemency of his temper was fuch that he readily pardoned thofe who offended him, and in few inftances was he induced to punifh. In his character, however, the virtue of benevolence fhone with peculiar fplendour among the other virtues of the Chriftian. A foreign minifter one day ufed the freedom to inquire at Amadeus, if he kept any hounds. The duke replied, "a great number, and you fhall fee them to-morrow at noon." The minifter attended at that hour in expectation of feeing a numerous pack of hounds; but the duke led him to a window which looked into an extenfive fquare, and directing his view to a multitude of poor people eating and drinking, he exclaimed, "Thefe are my hounds with whom I go in chafe of heaven." In all thefe pious and benevolent labours he was feconded by his wife Iolande of France. When one of his parfimonious courtiers reminded him that he would fpend all his revenues, he generoufly replied, "Here is the collar of my order, let them fell it and relieve my people." In the feventh year of his reign, and the thirty-feventh of his life, he died univerfally lamented by all his loyal fubjects, in the year 1472. In high efteem for his virtuous qualities, his fubjects conferred on him the appellation of *The Bleffed*. (*Mod. Univ. Hift.*)

AMADIA, a trading town of Afia, in Curdiftan, belonging to the Turks; feated on a high mountain. E. Long. 43. 1. N. Lat. 36. 25.

AMADOW, a kind of black match, tinder, or touchwood, which comes from Germany. It is made

of a fort of large mufhrooms or fpongy excrefcences, which commonly grow on old trees, efpecially oaks, afh, and firs. This fubftance being boiled in common water, and afterwards dried and well beaten, is then put into a ftrong ley prepared with faltpetre, after which it is again put to dry in an oven. The druggifts fell this match wholefale in France, and feveral hawkers retail it. Some give to the amadow the name of *pyrotechnical fponge*, becaufe of its aptnefs to take fire.

AMADOWRY, a kind of cotton which comes from Alexandria by the way of Marfeilles.

AMAIN, in the *Sea Language*, a term importing to lower fomething at once. Thus, *to ftrike amain*, is to lower or let fall the topfails; *to wave amain*, is to make a fignal, by waving a drawn fword, or the like, as a demand that the enemy ftrike their topfails.

AMAK, a fmall ifland in the Baltic fea, near Copenhagen, from which it is feparated by a canal over which there is a drawbridge. Amak is about four miles long and two broad; and is chiefly peopled by the defcendants of a colony from Eaft Friefland, to whom the ifland was configned by Chriftian II. at the requeft of his wife Elizabeth, fifter of Charles V. for the purpofe of fupplying her with vegetables, cheefe, and butter. From the intermarriages of thefe colonifts with the Danes, the prefent inhabitants are chiefly defcended; but as they wear their own drefs, and enjoy peculiar privileges, they appear a diftinct race from the natives. The ifland contains about fix villages, and between 3000 and 4000 fouls. It has two churches, in which the minifters preach occafionally in Dutch and Danifh. The inhabitants have their own inferior tribunals; but in capital offences are amenable to the king's court of juftice at Copenhagen. The old national habit, brought by the original colony when they firft migrated to the ifland, is ftill in ufe amongft them. It refembles the habit of the ancient Quakers, as reprefented in the pictures of the Dutch and Flemifh painters. The men wear broad-brimmed hats, black jackets, full glazed breeches of the fame colour, loofe at the knee, and tied round the waift. The women were dreffed chiefly in black jackets and petticoats, with a piece of blue glazed cloth bound on their heads. The ifland is laid out in gardens and paftures; and ftill, according to the original defign, fupplies Copenhagen with milk, butter, and vegetables. E. Long. 12. 10. N. Lat. 55. 20.

AMAL, a town of Sweden, in the province of Daland, feated on the river Wefer. It has a good harbour, and carries on a great trade, efpecially in timber, deals, and tar. E. Long. 12. 40. N. Lat. 58. 50.

AMALARIC, was the fon of Alaric II. and king of the Vifigoths. Deprived of his father when an infant, he would have been bereft of his crown, had not his grandfather Theodoric king of the Oftrogoths interpofed in his behalf. In defence of the royal infant, he expelled from the throne his natural brother, who had ufurped the government and ruled the kingdom during his life, and preferved the crown to the natural heir. In 526 the grandfather died, and Amalaric affumed the royal authority. In 517 he married Clotilda, the daughter of Clovis, an amiable lady, who inherited both the piety and orthodoxy of her mother, who was of the fame name. The Catholic hifto-

Amalaric, Amalasontha. rians relate, that the king being violently attached to the Arian cause, used means to compel his queen to embrace the same opinions; which participated more of cruelty than piety. With all the firmness of a great mind, and the amiable patience of a Christian, she endured her wrongs for a considerable period; but at length, worn out with injurious treatment, she was forced to apply to her brothers for assistance, and sent them a handkerchief stained with her blood in proof of her cruel usage. In order to relieve their sister, one of them, Childebert king of Paris, entered the territories of Amalaric, who then resided with his court at Narbonne; and their different forces having joined battle, the troops of Amalaric were totally defeated, and the king himself forced to save his life by flying into Spain, A. D. 531. It is reported that, when endeavouring to regain Narbonne, he was slain either by an assassin employed by Theudis his successor, or that he fell in battle. Some historians again say, that he died in Barcelona. *(Gen. Biog.)*

AMALASONTHA, youngest daughter of Theodoric the Great, king of the Ostrogoths, was born about the year 498. The sister of Clovis was her mother, and in 515, she married Eutharic the only remaining heir of the legal race of the Amali. Her father having formed the design of making him his successor, he sent to bring him from Spain for that purpose. But he never arrived at the destined honour; for Eutharic died previous to his father-in-law, and his only son Athalaric, was also bereft of his grandfather at the age of eight years. The well known abilities of Amalasontha induced Theodoric to place Athalaric, to whom he had left the kingdom of Italy, under the care of his mother. This princess inherited an ample share of her father's talents; and her father had been exceedingly careful to improve these natural endowments by means of a liberal education. She became a great proficient in the philosophy and morals of that age, and with equal elegance and grace she could converse in the Greek, Latin, and Gothic languages. Nor were her talents merely qualified to adorn private life: she displayed them in the administration of public justice, and political discussion. Her first efforts were in behalf of the injured children of Boethius and Symmachus, whom she reinstated in the possession of their inheritance. When the chiefs of the Goths were strongly inclined to treat the Romans as a conquered people, she mildly restrained their violent oppression and their ungovernable rapacity. Adorning the female character she relieved her subjects from some of the severer impositions of her father; but carefully retained all his laws, magistrates, and political institutions. Having herself tasted of the sweets of literature, and experienced its advantages, she patronized learning with an assiduous care, by regularly paying the salaries of public teachers, and giving every encouragement to the improvement of genius. Her peaceable deportment towards the neighbouring princes forms an amiable feature in her character. Both with the imperial court, and with all the other powers, she lived upon agreeable terms, and thus universal prosperity and honour prevailed. Both in consequence of maternal affection and the high cultivation of her mind, she exerted all her ingenuity in the education of her orphan son. Unfortunately, however, both for the mother and the son, neither the general character of the Gothic nation, nor the wayward inclinations of the boy, seconded her laudable endeavours. The Gothic nobles had just commenced their murmurings against the soft effeminate manner in which their prince was educating, when, upon a certain day, the youth having undergone some kind maternal chastisement, rushed into the room where some of the nobles were assembled, with the tears streaming from his eyes. Informed of the cause of his distress, the wrath of the nobles suddenly arose, and in a violent burst of passion they insisted upon the immediate release of their prince from the bondage of learning and from the restraints of a mother. The unfortunate youth was thus dragged from the habitation of learning, prudence, and virtue; and plunged into all the extravagancies of dissolute pleasure, and his mind inspired with contempt and aversion to his virtuous mother.

Amalasontha, Amalek. It was impossible for humanity to bear this insult and high injury without opposition; therefore, in the first effusions of her resentment she seized three of the principal persons concerned in this transaction, and confined them in one of the remotest parts of Italy. But the efforts of one, or of a few individuals, are never adequate to the task of counteracting the general efforts of a nation, for the party whose sentiments were opposed to her's, grew daily in magnitude and strength, to such a degree that Amalasontha formed serious resolutions of sheltering herself under the protection of Justinian. After a correspondence had been carried on to prepare for this event, and when she was about to sail for that place, she determined to make one bold effort to regain her absolute power. With this view, she caused the three persons who were in confinement to be secretly assassinated; and this action re-established her authority, although it augmented the public hatred. But another cause of disquiet soon arose. At the early age of sixteen, her son fell a victim to his debaucheries and follies, and she was left devoid of any legal claim to the crown. The accomplished and ambitious Amalasontha spurned the idea of retiring to a private station, and formed the bold design of sharing the throne with Theodotus her cousin. She had sufficient penetration to perceive that the dispositions of that youth were indolent and weak, and consequently she hoped still to remain at the helm of government. But the future fortune of that accomplished woman, demonstrates to posterity the danger of confiding in human weakness, where the principles of honour and justice and virtue are wanting. Theodotus issued an order for her confinement in an island in the lake Bolsena; and in the year 535 she was strangled in the bath. Some historians ascribe this action to the influence of the empress Theodora, who was seized with jealousy in consequence of the respect shown her by Justinian. *(Gen. Biog.)*

AMALEK, the son of Eliphaz, by Timna his concubine, and the grandson of Esau, Gen. xxxvi. 12. and 1 Chr. i. 36. Amalek succeeded Gatam in the government of Edom. He was the father of the Amalekites; a powerful people who dwelt in Arabia Petræa, between the Dead sea and the Red sea, or between Havila and Shur (1 Sam, xv. 7.); sometimes in one canton and sometimes in another. It does not appear that they

Amalek.

they had cities; for there is no mention of any but one in the Scriptures (*id. ib.* 5.); they living generally in hamlets, caves, or tents.

The Israelites had scarcely passed the Red sea on their way to the wilderness before the Amalekites came to attack them in the deserts of Rephidim (Ex. xvii. 8. &c.); and put those cruelly to the sword who were obliged, either through fatigue or weakness, to remain behind. Moses, by divine command, directed Joshua to fall upon this people; to record the act of inhumanity which they had committed in a book, in order to have it always before his eyes; and to revenge it in the most remarkable manner. Joshua therefore fell upon the Amalekites and defeated them, while Moses was upon the mountain, with Aaron and Hur in company. Moses, during the time of the engagement, held up his hands, to which the success of the battle was owing; for as often as he let them down, Amalek prevailed. But Moses's hands being tired, Aaron and Hur supported his arms, and held them extended, while the battle lasted, which was from morning till the approach of night, when the Amalekites were cut in pieces. This happened in the year of the world 2513, before Christ 1491.

The ground of the enmity of the Amalekites against the Israelites is generally supposed to have been an innate hatred, from the remembrance of Jacob's depriving their progenitor both of his birthright and blessing. Their falling upon them, however, and that without any provocation, when they saw them reduced to so low a condition by the fatigue of their march, and the excessive drought they laboured under, was an inhuman action, and justly deserved the defeat which Joshua gave them. Under the Judges (v. 3.), we see the Amalekites united with the Midianites and Moabites, in a design to oppress Israel; but Ehud delivered the Israelites from Eglon king of the Moabites (Judges iii.), and Gideon (chap. viii.) delivered them from the Midianites and Amalekites. About the year of the world 2930, Saul marched against the Amalekites, advanced as far as their capital, and put all the people of the country to the sword; but spared the best of all the cattle and moveables, contrary to a divine command; which act of disobedience was the cause of Saul's future misfortunes.

After this war, the Amalekites scarcely appear any more in history. However, about the year of the world 2949, a troop of Amalekites came and pillaged Ziklag, which belonged to David (1 Sam. xxx.), where he had left his two wives Ahinoam and Abigail; but he returning from an expedition which he had made in the company of Achish into the valley of Jezreel, pursued them, overtook and dispersed them, and recovered all the booty which they had carried off from Ziklag.

The Arabians maintain Amalek to have been the son of Ham, and grandson of Noah; that he was the father of Ad, and grandfather of Schedad. Calmet thinks that this opinion is by no means to be rejected, as it is not very probable that Amalek, the son of Eliphaz, and grandson of Esau, should be the father of a people so powerful and numerous as the Amalekites were when the Israelites departed out of Egypt. Moses in the book of Genesis (xiv. 7.) relates, that in Abraham's time, long before the birth of Amalek the son of Eliphaz, the five confederate kings carried the war into Amalek's country, about Kadesh; and into that of the Amorites, about Hazezon-tamar. The same Moses (Num. xxiv. 20.) relates, that the diviner Balaam, observing at a distance the land of Amalek, said, in his prophetic style, "Amalek is the first, the head, the original of the nations; but his latter end shall be, that he perish for ever." Our commentator observes, that this epithet of the first of nations cannot certainly agree with the Amalekites descended from the son of Eliphaz, because the generation then living was but the third from Amalek. Besides, Moses never reproaches the Amalekites with attacking their brethren the Israelites; an aggravating circumstance, which he would not have omitted were the Amalekites descended from Esau; in which case they had been the brethren of the Israelites. Lastly, We see the Amalekites almost always joined in the Scripture with the Canaanites and Philistines, and never with the Edomites; and when Saul made war upon the Amalekites, and almost utterly destroyed them, we do not find that the Edomites made the least motion towards their assistance, nor to revenge them afterwards. Thence it is thought probable, that the Amalekites, who are so often mentioned in Scripture, were a free people descended from Canaan, and devoted to the curse as well as the other Amorites, and very different from the descendants of Amalek, the grandson of Esau.

Amalek, Amalfi.

The accounts which the Arabians give us of the Amalekites destroyed by Saul are as follow: Amalek was the father of an ancient tribe in Arabia, exterminated in the reign of Saul. This tribe contained only the Arabians who are called *Pure;* the remains whereof were mingled with the posterity of Joktan and Adnan, and so became Mosarabes or Mostaarabes; that is to say, Arabians blended with foreign nations. They further believe, that Goliath, who was overcome by David, was king of the Amalekites; and that the giants who inhabited Palestine in Joshua's time were of the same race. That at last part of the Amalekites retired into Africa while Joshua was yet living, and settled upon the coasts of Barbary, along the Mediterranean sea. The son of Amalek was Ad, a celebrated prince among the Arabians. Some make him the son of Uz, and grandson of Aram the son of Shem. Let this be as it will, the Mahometans say that Ad was the father of an Arabian tribe called *Adites;* who were exterminated, as they tell us, for not hearkening to the patriarch Eber, who preached the unity of God to them. Ad had two sons, Schedad and Schedid.

AMALFI, an ancient city of Italy, situated in E. Long. 15. 20. N. Lat. 40. 35. It is said to have derived its origin from a number of Roman families, who, about the middle of the fourth century, either from private views of emolument, or in consequence of compulsory orders from the emperor, had left Rome, and embarked for Constantinople; but meeting with storms on their passage, were cast away on the shores of Salerno, and deprived of the means of pursuing their voyage. In this state of perplexity they long remained; but at last came to the resolution of settling on the present site of Amalfi, where they expected to enjoy security, and sufficient plenty of the necessaries of life. The earliest notice of them in this settlement dates no higher than the latter end of the sixth century. Impervious mountains and inacceſſible coaſts preſerved their infant ſtate from the firſt fury of the Lombards, who ſeldom attempted the conqueſt of a maritime people.

In the year 825, when this little republic had, under the patronage of the eaſtern emperors, attained a degree of wealth and reputation ſufficient to excite the ambition of its neighbours, Sico, prince of Salerno, marched a body of troops by night, ſurpriſed Amalfi; and, carrying off the greateſt part of the inhabitants, compelled them to fix at Salerno, which had lately ſuffered a great loſs of people by an epidemical diſorder. But before the fourth year of their captivity was expired, the Amalfitans took advantage of the abſence of the Salernitan chiefs, who were then carrying on a war with the Beneventans; armed themſelves; and, after burning and plundering Salerno, marched in triumph back to their own country.

Here they framed a better ſyſtem of government, and reformed many abuſes in their former legiſlation; adopting various meaſures that were likely to promote internal concord, and defeat the evil intentions of foreign enemies. Their firſt plan was to veſt the ſupreme authority in a temporary prefect; but the experience of a few years cauſed them to prefer lodging that power in the hands of a duke elected for the term of his natural life. Under theſe governors Amalfi attained the ſummit of her military and commercial glory. It extended its territory, which reached eaſtward from Vico Vecchio, and weſtward to the promontory of Minerva, including likewiſe the iſland of Caprea, and the two iſlands of the Galli. Towards the north, it comprehended the cities of Lettere, Gragnans, Pimontio, and Capule di Franchi; towards the ſouth, thoſe of Scala, Ravelli, Minori, Majuri, Atrani, Tramonti, Agerula, Citara, Prajano, and Roſilano.

Leo IV. found the Amalfitans an uſeful ally in his wars with the Infidels, and honoured the commonwealth with the title of *Defender of the Faith*. The Neapolitans, with whom, as Greek vaſſals, they were united in ſtrict bonds of friendſhip, experienced many ſignal favours at their hands; and the Muſſulmans themſelves found it expedient to court their alliance, and to enter into treaty with them. Their ſituation had from the beginning given them a turn to commerce, and their attention to naval affairs ſo much conſequence in the eyes of their protector, the emperor of Conſtantinople, that by his orders a court was eſtabliſhed at Amalfi, for the deciſion of all controverſies ariſing in maritime tranſactions. Its code and reports became the general rule in thoſe caſes throughout this part of Europe; its precedents and decrees were allowed to be good authority to found judgment upon even in foreign tribunals. To crown the mercantile and naval glory of the republic, it was reſerved to the lot of an Amalfitan to make, or at leaſt to perfect, the moſt important diſcovery ever made for the improvement of navigation. Paſitano, a village which ſtands on the ſhore a few miles weſt of Amalfi, boaſts of having given birth to Flavius Gioia, the inventor of the mariner's compaſs.

The merchants of this town engroſſed the trade of the Levant, and tranſacted the commercial buſineſs of the world in a lucrative and excluſive manner. The Piſans, Venetians, and Genoeſe, roſe upon their ruin; and, after monopolizing the emoluments of trade for ſome ages, made way for the more comprehenſive and daring ſpirit of the preſent maritime powers.

At preſent Amalfi is ſubject to Naples, and is the ſee of an archbiſhop. It is but a ſhadow of what it was in its flouriſhing ſtate, when it extended over the ſtupendous rocks that hang on each ſide, ſtill crowned with battlemented walls and ruined towers. Its buildings, Mr Swinburne ſays, are not remarkable for elegance or ſize; and contain at moſt 4000 inhabitants, who ſeem to be in a poor line of life. The cathedral is an uncouth building. Under the choir is the chapel and tomb of the apoſtle St Andrew; to whoſe honour the edifice was dedicated, when Cardinal Capuano, in 1208, brought his body from Conſtantinople.

AMALGAM, mercury united with ſome metal.

AMALGAMATION, the operation of making an amalgam, or mixing mercury with any metal.

For the combination of one metal with another, it is generally ſufficient that one of them be in a ſtate of fluidity. Mercury being always fluid, is therefore capable of amalgamation with other metals without heat; nevertheleſs, heat conſiderably facilitates the operation.

To amalgamate without heat requires nothing more than rubbing the two metals together in a mortar; but the metal to be united with the mercury ſhould be previouſly divided into very thin plates or grains. When heat is uſed (which is always moſt effectual, and with ſome metals indiſpenſably neceſſary), the mercury ſhould be heated till it begins to ſmoke, and the grains of metal made red hot before they are thrown into it. If it be gold or ſilver, it is ſufficient to ſtir the fluid with an iron rod for a little while, and then throw it into a veſſel filled with water. This amalgam is uſed for gilding or ſilvering on copper, which is afterwards expoſed to a degree of heat ſufficient to evaporate the mercury.

Amalgamation with lead or tin is effected by pouring an equal weight of mercury into either of theſe metals in a ſtate of fuſion, and ſtirring with an iron rod. Copper amalgamates with great difficulty, and iron not at all.

AMALTHÆA, the name of the Cumæan Sibyl, who offered to Tarquinius Superbus nine books, containing the Roman deſtinies, and demanded 300 pieces of gold for them. He derided her; whereupon ſhe threw three of them into the fire; and returning, aſked the ſame price for the other ſix; which being denied, ſhe burnt three more; and returned, ſtill demanding the ſame price. Upon which Tarquin conſulting the pontiffs, was adviſed to buy them. Theſe books were in ſuch eſteem, that two magiſtrates were created to conſult them upon extraordinary occaſions.

Amalthæa, in *Pagan Mythology*, the daughter of Meliſſus, king of Crete, and the nurſe of Jupiter, whom ſhe fed with goats milk and honey. According to others, Amalthæa was a goat, which Jupiter tranſlated into the ſky, with her two kids, and gave one of her horns to the daughters of Meliſſus, as a reward for the pains they had taken in attending him. This horn had the peculiar property of furniſhing them with whatever they wiſhed for; and was thence called the *cornucopiæ*, or horn of plenty.

AMALTHÆUS, Jerome, John Baptista, and Corneille, three celebrated Latin poets of Italy, who flouriſhed in the 16th century. Their compoſitions were printed at Amſterdam in 1685. One of the prettieſt pieces in that collection is an epigram on two children, whoſe beauty was very extraordinary, though each of them was deprived of an eye:

Lumine Acon dextro, capta eſt Leonilla ſiniſtro:
Et poterat forma vincere uterque Deos,
Parve puer, lumen quod habes concede ſorori;
Sic tu cæcus Amor, ſic erit illa Venus.

AMAMA, Sixtinus, profeſſor of the Hebrew tongue in the univerſity of Franeker, a man of great learning, was born in Frieſland, and had ſtudied under Druſius. He publiſhed a criticiſm upon the tranſlation of the Pentateuch; collated the Dutch tranſlation of the Bible with the original and the moſt accurate tranſlations; and wrote a cenſure of the Vulgate tranſlation of the hiſtorical books of the Old Teſtament, Job, the Pſalms, and Canticles. It is impoſſible to anſwer the reaſons whereby he ſhows the neceſſity of conſulting the originals. This he recommended ſo earneſtly, that ſome ſynods, being influenced by his reaſons, decreed, that none ſhould be admitted into the miniſtry, but ſuch as had a competent knowledge of the Hebrew and Greek text of the Scriptures. He died in 1629.

AMANCE, a town in the duchy of Lorraine, upon a rivulet of the ſame name. E. Long. 6. 10. N. Lat. 48. 45.

AMAND, Mark Anthony Gerard, Sieur de St, a French poet, was born at Rouen in Normandy in 1594. In the epiſtle dedicatory to the third part of his works, he tells us, that his father commanded a ſquadron of ſhips in the ſervice of Elizabeth queen of England for 22 years, and that he was for three years priſoner in the Black Tower at Conſtantinople. He mentions alſo that two brothers of his had been killed in an engagement againſt the Turks. His own life was ſpent in a continual ſucceſſion of travels, which was of no advantage to his fortune. There are miſcellaneous poems of this author, the greateſt part of which are of the comic or burleſque, and the amorous kind. Though there are many blemiſhes in his poems, yet he had the talent of reading them in ſo agreeable a manner, that every one was charmed with them. In 1650, he publiſhed *Stances ſur la groſſeſſe de la reine de Pologne et de Suede*. There are ſix ſtanzas of nine verſes each. In 1653, he printed his *Moiſe ſauve, idyle heroique*. This poem had at firſt many admirers; M. Chapelein called it a *ſpeaking picture;* but it has ſince fallen into contempt. Amand wrote alſo a very devout piece, entitled, *Stances à M. Corneille, ſur ſon imitation de Jeſus Chriſt*, which was printed at Paris in 1656. M. Broſſette ſays, that he wrote alſo a poem upon the moon, wherein he paid a compliment to Lewis XIV. upon his ſkill in ſwimming, in which he uſed often to exerciſe himſelf when he was young, in the river Seine; but the king could not bear this poem to be read to him, which is ſaid to have affected the author to ſuch a degree, that he did not ſurvive it long. He died in 1661, being 67 years of age. He was admitted a member of the French academy, when it was firſt founded by Cardinal Richelieu, in the year 1633; and Mr Peliſſon informs us, that in 1637, at his own deſire, he was excuſed from the obligation of making a ſpeech in his turn, on condition that he would compile the comic part of the dictionary which the Academy had undertaken, and collect the burleſque terms. This was a taſk well ſuited to him; for it appears by his writings, that he was extremely converſant in theſe terms, of which he ſeems to have made a complete collection from the markets, and other places where the lower people reſort.

Amand, *Saint*, a city of France, in the department of Cher, formerly Bourbonois, on the confines of Berry, ſeated on the river Cher. It was built in 1410, on the ruins of Orval. E. Long. 9. 30. N. Lat. 46. 32.

Amand, *Saint*, a city of France, in the department of the North, ſeated on the river Scarpe. It contains about 600 houſes, and 3000 or 4000 inhabitants. The abbot of the place is the temporal lord, and diſpoſes of the magiſtracy. It was given to France by the treaty of Utrecht. E. Long. 2. 35. N. Lat. 50. 27.

AMANICÆ pylæ (Ptolemy); Amanides Pylæ (Strabo); Amani Portæ (Pliny); Straits or defiles in Mount Amanus, through which Darius entered Cilicia; at a greater diſtance from the ſea than the Pylæ Ciliciæ or Syriæ, through which Alexander paſſed.

AMANTEA, a ſea-port town and biſhop's ſee of the kingdom of Naples, ſituated near the bay of Euphemia, in the province of Calabria, in E. Long. 16. 20. N. Lat. 39. 15.

AMANUS, a mountain of Syria, ſeparating it from Cilicia; a branch of Mount Taurus (Cicero, ſtrabo, Pliny); extending chiefly eaſtward, from the ſea of Cilicia to the Euphrates: Now called *Monte Negro*, or rather *Montagna Neres*, by the inhabitants; that is, the watery mountain, as abounding in ſprings and rivulets.

AMAPALLA, a city and port town of North America, in the province of Guatimala, ſeated on the gulf of the ſame name, in the Pacific ocean. W. Long. 63. 20. N. Lat. 12. 30.

AMARANTE, an order of knighthood, inſtituted in Sweden by Queen Chriſtina, in 1653, at the cloſe of an annual feaſt, celebrated in that country, called *Wirtſchaft*. This feaſt was ſolemnized with entertainments, balls, maſquerades, and the like diverſions, and continued from evening till the next morning.—That princeſs, thinking the name too vulgar, changed it into that of the *feaſt of the gods*, in regard each perſon here repreſented ſome deity as it fell to his lot. The queen aſſumed the name of *Amarante;* that is, unfading, or immortal. The young nobility, dreſſed in the habit of nymphs and ſhepherds, ſerved the gods at the table. At the end of the feaſt, the queen threw off her habit, which was covered with diamonds, leaving it to be pulled in pieces by the maſques; and in memory of ſo gallant a feaſt, founded a military order, called in Swediſh *Geſchilſchafft*, into which all that had been preſent at the feaſt were admitted, including 16 lords and as many ladies, beſides the queen. Their device was the cypher of *Amarante*, compoſed of two A's, the one erect, the other inverted, and interwoven together; the whole encloſed by a laurel crown, with this motto, *Dolce nella memoria.*

Bulstrode Whitlock, the English ambassador from Cromwell to the court of Sweden, was made a knight of the order of *Amarante:* on which account it seems to be, that we sometimes find him styled *Sir Bulstrode Whitlock*.

AMARANTHOIDES, in *Botany*, the trivial name of a species of illecebrum. See ILLECEBRUM, BOTANY *Index*.

AMARANTHUS (of α privative, and μαραινω, *to wither*, because the flower of this plant, when cropped, does not soon wither), AMARANTH, OR FLOWER GENTLE. See BOTANY *Index*.

AMARGURA, an island in the Southern Pacific ocean, discovered by Maurelle in 1781. It is quite barren, and inaccessible even to boats. S. Lat. 17. 57. W. Long. 175. 17.

AMARYLLIS, LILY-ASPHODEL. See BOTANY *Index*.

AMARYNTHUS, in *Ancient Geography*, a hamlet of Eretrias, in the island of Eubœa, about seven stadia distant from its walls. Here Diana was worshipped in an annual solemnity, at which those of Carystus assisted; hence the title of the goddess was *Amarynthis* and *Amarysia*.

AMASIA, in *Ancient Geography*, now *Marpurg*, a city in the landgravate of Hesse, on the Lahn. According to others, it is Embden in Westphalia.

AMASIA, an ancient town of Turkey, in Natolia, remarkable for the birth of Strabo the geographer. It is the residence of a bashaw, and gives its name to the province it stands in, where there are the best wines and the best fruits in Natolia. It is seated near the river Iris or Casalmack; and was anciently the residence of the kings of Cappadocia. E. Long. 36. 10. N. Lat. 39. 33.

AMASIA, the name of the northern division of Lesser Asia, lying on the south shore of the Euxine sea, in Natolia. It takes its name from Amasia the capital, mentioned in the preceding article.

AMASIS, king of Egypt, ascended the throne B. C. 569, and commenced his reign with the death of his former master Apries. King Apries having sent an army to the assistance of the Libyans, which was totally routed, and great multitudes put to death, the common people conceived the idea, that the tyrannical prince had sent them to the field of battle, for no other purpose but to destroy great numbers of them, that so he might reign over the remainder with uncontrolled oppression. The consequence was, that a general insurrection arose, and all the multitude were in an uproar. Informed of this tumult, Apries sent Amasis, whom he deemed one of his most faithful adherents; but instead of endeavouring to reconcile the disaffected people to their prince, he secured them to his own interest; and while he was pretending to reproach their disloyalty, and endeavouring to recall them to duty, a soldier stepped in behind him, and placing a helmet upon his head, saluted him king of Egypt. Amasis instantly took the field against his royal master, and prepared to drive him from his throne. Apprised of the treachery of Amasis, he sent another in whom he confided, to bring Amasis before him, to give an account of his conduct. This messenger met him on horseback, and having delivered his message, Amasis after some insolent behaviour, replied, that he was preparing to visit the king, but thought it proper to bring a suitable equipage to attend him. When the messenger hastened back to inform his master, that he might consult for himself, his only reward was to have his ears and nose cut off, by the order of the tyrant, because he brought not Amasis along with him. In this, as in numerous other instances, tyranny procured its own destruction; for the rest of the nobles who still remained obedient to the king, seeing the barbarous manner in which he had treated the messenger, they all went over to the standard of the usurper. Now all the nation was in commotion. The usurper on the one hand, with the whole body of the natives marshalled under his banner, and the tyrant on the other hand, with a body of foreigners and mercenaries, which he had engaged in his service. The two armies met in a field in the vicinity of Memphis, and the tyrant was made captive and his forces defeated. The usurper treated the captive tyrant with great lenity and respect, and assigned him the palace of Saïs for his confinement. But the hatred of the people was too violent towards their old king, to permit him to live; Amasis was therefore forced to deliver him into their hands, and they instantly put him to death by strangling him.

The plebeian extraction of Amasis deprived him for some time of that respect, to which he was entitled as a prince; but observing this, he contrived a stratagem to induce them to pay him suitable honour. He ordered a golden cistern, in which his visitants were accustomed to wash their feet, to be melted and cast in the form of a god, and set it up in the most frequented part of the city, and all the inhabitants did it homage. He then called an assembly of the people, and reminded them, that the gold they now venerated in the form of a god, was once a cistern, and consequently that although he was formerly a person of low rank, yet now that he was their king, they ought to give him the respect and homage due to his station.

Having by this means provided for the gratification of his vanity, he began to exert himself to act for the general good of his people. It was his constant practice to attend to business in the mornings, and in the evenings he indulged in amusement and pleasure; but in these he sometimes tarnished the dignity of a king. Indeed Amasis loved his wine and his companion so much, previous to his elevation, that it is reported that he lived by theft, and when denying upon detection, he was carried to the oracle of the place, who sometimes condemned and sometimes acquitted him. Recollecting the conduct of the oracles after he ascended the throne, he conceived a disrespect for them, because they were not able at all times to detect his robberies.

To prevent the evil consequences of an indolent populace, he enacted a law, that every person, under the penalty of capital punishment, should appear before the governor of his respective province, and declare by what occupation he acquired his subsistence. Thus, under the prudent government of Amasis, Egypt enjoyed for many years, great fertility and extensive population. He also employed his industry in the erection of several public works; among which were a portico to the temple of Minerva at Saïs, and the removal of a house, all of one stone, to the temple. He also

also built the great temple of Isis at Memphis. He likewise erected a colossus before the temple of Vulcan, 75 feet in length, resting on its back, and on the basis he erected two statues, each 20 feet high, cut out of the same stone. Besides these he raised several monuments in Greece.

The liberality and respect for science which Amasis displayed, and the encouragement he gave to learned strangers, particularly to the Greeks, to visit his country, manifested an enlightened mind. And to encourage Grecian strangers to remain in Egypt, he marked out settlements for them on the sea-coast, permitted them to build temples, and to observe all the rites of their religion unmolested. Solon, the celebrated lawgiver, condescended to visit Amasis. In a short time, the fame of Amasis for his generosity and humanity was so extensive, that when the Delphians were going about from city to city, collecting sums to enable them to rebuild their consumed temple, they applied to Amasis, who gave them 1000 talents. Either to gratify the vanity, or secure the alliance of the Greeks, he married a Grecian lady, named Laodice, the daughter of Battus. But in the evening of his reign his prosperity was greatly clouded, by the report of the vast preparations that Cambyses was making to invade Egypt. Phanes, who was captain of the Greek auxiliaries in the service of Amasis, being offended at his master, deserted his cause, and went over to Cambyses. A strong affection had long subsisted betwixt Polycrates, the tyrant of Samos, and Amasis; yet he, deserting his cause, became his enemy. Whether the forebodings of the impending storm tended to impair his health or not is not related; but about this time he died, in 525 B. C. after a reign of 44 years. It is reported that, after interment, his body was dug up by his enemies, and consumed by fire, which, according to the superstition of the Egyptians, constituted a singular calamity. (*Anc. Univ. Hist.*)

AMASONIA. See Botany *Index*.

AMATHUS, a very ancient town in the south of Cyprus (Strabo, Ptolemy): so called from Amathus the founder; or, according to others, from Amath, a Phœnician town sacred to Venus, with a very ancient temple of Adonis and Venus: and hence Venus is denominated *Amathusia* (Tacitus). According to Ovid, it was a place rich in copper ore, and where the inhabitants became *Cerastæ*, or horned. Now called *Limisso.*

Amathus, in *Ancient Geography*, a town of the tribe of Gad, beyond Jordan; but whether at a greater or less distance from it, is not so easy to determine. Eusebius places it in the lower Peræa; Reland, in Ramoth Gilead. Gabinius, proconsul of Syria, established five juridical conventions in Judæa; two of which were on the other side Jordan; one at Gadara, the other at Amathus (Josephus).

AMATIQUES, a sea-port town, in the province of Vera Paz in Mexico, at the mouth of the river Guanacos, which flows into the gulf of Honduras. The inhabitants are chiefly employed in cutting logwood. N. Lat. 15. 23. W. Long. 89. 0.

AMATORII musculi, in *Anatomy*, a term sometimes used for the obliquus superior and obliquus inferior muscles of the eye, as these muscles assist in ogling or drawing the eye sidewise.

AMATRICE, a city of the kingdom of Naples in the farther Abruzzo, upon the confines of the pope's territories, and the marquisate of Ancona.

AMATTA, Foa, an island in the Southern Pacific ocean, which was discovered by Captain Cook in 1774. It is about five leagues in circumference, and considerably elevated; it is inhabited, but not very fertile; and it lies about twelve leagues distant, and north-north-west from Anamooka.

AMAUROSIS, in *Medicine*, a deprivation of sight, the eye remaining fair and seemingly unaffected. A perfect amaurosis is when the blindness is total; when there is still a power of distinguishing light from darkness, the disease is called by M. de St Ives an *imperfect amaurosis*. There is a periodical sort which comes on instantaneously, continues for hours, or days, and then disappears.

AMAZIAH, one of the kings of Judah, ascended the throne of his father Joash in the 25th year of his age. His mother's name was Jehoddan, a native of Jerusalem. In consequence of his wavering virtue, and his mingling foreign idolatry with the worship of the true God, he is said, according to Scripture, to have done that which was right in the sight of the Lord, but "not with a perfect heart." His father had been ungenerously murdered by his own servants, therefore his son, on his elevation to the throne, put to death the murderers of his father. In this act of remunerative justice, however, he showed a becoming respect to the law of Moses, which prohibited the punishing of the children for the crimes of their guilty fathers. He gave early proofs of his military talents, by making a general muster of all his subjects able to bear arms; and likewise hired a numerous army from the neighbouring kingdom of Israel; and with this increased multitude he hastened to attack Edom. The two kindred armies met together in the valley of Salt, and, after an obstinate engagement, the Edomites were put to flight; and Amaziah from thence proceeded to take the town of Selah. But the spirit of jealousy arose between the two armies, so that Amaziah thought it prudent not to make use of the arms of the Israelitish auxiliaries, consequently issued an order for their returning home; but this treatment roused the martial spirit and indignant temper of the Israelites to such a height, that, on their return, they turned their arms against the cities of Judah, and ravaged and destroyed them. The imperfection of the heart of Amaziah was fully displayed on this occasion; for he is related to have brought home the gods of the children of Seir, who were unable to protect their own votaries, and in the folly of his heart to have paid them divine honours. Flushed with the success of his arms in the valley of Salt, he sent a hostile challenge to Jehoash king of Israel, expressed in the phraseology of those times, that they should "look one another in the face. Pride goeth before destruction, and a haughty spirit before a fall." In vain the prudent and peaceful spirit of Jehoash endeavoured to persuade him from his bold attempt. They saw one another in the face at Bethshemesh, and Amaziah was made prisoner, and the men of Judah put to flight. Jehoash advanced to the capital, carrying the vanquished king along with him; and he entered the city by breaking a large portion of the wall; and, after plundering the temple and the king's

Amazonia. king's palace, he returned home in triumph to Samaria. This misfortune seems to have damped the military ardour of Amaziah; for, although he swayed the sceptre over Judah for many years after, yet he never engaged in any hostile contentions with his neighbours. Whether, through the oppressive conduct of Amaziah or whatever cause, it is certain that a conspiracy was formed against him in Jerusalem, which compelled him to fly to the city of Lachish for shelter; but the confederacy was so strong and numerous, that his enemies pursued him thither; and there he fell by their hands, in the 29th year of his reign. (2 Kings xiv. 2 Chron. xxv.)

AMAZONIA, or the country of the American AMAZONS, is situated between 50 and 70 degrees of west longitude; and between the equator and 15 degrees of south latitude; being bounded on the south by La Plata, on the west by Peru, on the north by the province of Terra Firma, and on the east by Brasil.

With respect to the Amazons said to have given name to this territory, they have been represented as governed and led to war only by their queen. No men were suffered to live among them; though those of some neighbouring nations were suffered to visit them, at a certain season, for the sake of procreation. The females issuing from this commerce were bred up with care, and instructed in what relates to war and government; as to the males, they were sent away into the country of their fathers. But no such nation is at present to be found, any more than the giants and cannibals mentioned by the first adventurers thither.

Amazonia is generally a flat region, abounding in woods, lakes, rivers, bogs, and morasses. The chief river, and one of the largest in the world, is that called the river of Amazons, or the Orellana, which is formed by two large rivers, the one rising in the province of Quito, a little south of the equator, in 73 degrees of west longitude, and the other, named *Xauxa*, rising in the lake of Bourbon, near the Andes, in 10 degrees of south latitude. These two rivers uniting on the confines of Peru and Amazonia, in three degrees odd minutes of south latitude, assume the name of Amazon; whence running eastward upwards of 200 miles, and afterwards inclining to the north, they fall into the Atlantic ocean by 84 channels, which in the rainy season overflow the adjacent country. Besides the two streams mentioned, a multitude of others, both on the north and south side, contribute to the formation of this extraordinary river. As it runs almost across the broadest part of South America, it is computed to be between 4000 and 5000 miles in length, including all its windings. Its channel from Junta de los Reyos, about 60 degrees from its head, to the river Maragnon, is from one to two leagues broad; it then widens from three to four, and becomes gradually broader as it approaches the ocean. Between the places last mentioned, its depth is from five to ten fathoms; but from Maragnon to Rio Negro it increases to 20 fathoms; after which it is sometimes 30, and sometimes 50 fathoms, or more, till it comes near the end of its course. It has no sand banks, nor does the shore shelve so as to render it dangerous for vessels. The manetu and tortoise abound both upon the banks of this and the other rivers; and the fishermen must be upon their guard against the crocodiles, alligators, and water serpents, which also swarm here.

Amazonia, Amazons.

The air, as in the countries under the same parallel, is observed to be nearly as cool under the equator as about the tropics, on account of the rains continuing longer, and the sky in that season being clouded. Besides, an easterly wind sets from the Atlantic up the river so strong, that vessels are carried by it against the stream.

The produce of the country is Indian corn and the cassava root, of which they make flour and bread; tobacco, cotton, sugar, sarsaparilla, yams, potatoes, and other roots. They have also plenty of venison, fish, and fowl. Among the latter are vast flocks of parrots of all colours, the flesh of which serves for food and the feathers for ornament. All the trees here are evergreens; and fruits, flowers, and herbage, are in perfection all the year round. The principal fruits are cocoa nuts, ananas or pine apples, guavas, bananas, and such others as are usually found between the tropics. The forest and timber trees are cedar, Brazil wood, oak, ebony, logwood, ironwood, so called from its weight and hardness, and several sorts of dying wood.

The natives are of the common stature, with good features, a copper complexion, black eyes and hair. It is computed that there are of them about 150 different tribes or nations, and the villages are so numerous as to be within call of one another. Among those the Homagues, a people near the head of the river, are famous for their cotton manufactures; the Jurines, who live between five and ten degrees of latitude, for their joiners work; and the Wrosissares for their earthen ware. The Topinambes, who inhabit a large island in the river, are remarkable for their strength. Some of those nations frequently make war upon each other. Their armour consists of darts, javelins, bows and arrows; and they wear targets of cane or fish-skin. They make slaves of their prisoners, whom they otherwise use very well. Every tribe is governed by its respective chief or king, the marks of whose dignity are a crown of parrots feathers, a chain of lions teeth or claws hung round his neck, or girt about his waist, and a wooden sword which he carries in his hand.

Most of those nations, except the Homagues, go naked. The women thrust pieces of cane through their ears and under lips, as well as through the skin of the pudenda. At the gristle of their noses they also hang glass beads, which wag to and fro when they speak. They are such skilful marksmen, that they will shoot fish as they swim; and what they catch they eat without either bread or salt. They worship images, which they always carry with them on their expeditions; but they neither have temples nor any order of priests; and permit both polygamy and concubinage.

The country affords neither gold nor silver mines; only a small quantity of the former is found in the rivulets which fall into the Amazon near its sources in Peru. While the Spaniards imagined that it contained those metals, they made great efforts from Peru to reduce this territory to subjection; till being at length undeceived, they abandoned the design.

AMAZONS, in *Antiquity*, a nation of female warriors, who founded an empire in Asia Minor, upon the river Thermodoon, along the coasts of the Black sea. They

Amazons. They are ſaid to have formed a ſtate, out of which men were excluded. What commerce they had with that ſex, was only with ſtrangers; they killed all their male children; and they cut off the right breaſts of their females, to make them more fit for the combat. From which laſt circumſtance it is that they are ſuppoſed to take their name, viz. from the privative α, and μαζος, *mamma*, "breaſt." But Dr Bryant, in his Analyſis of Ancient Mythology, explodes this account as fabulous; and obſerves, that they were in general Cuthite colonies from Egypt and Syria, who formed ſettlements in different countries, and that they derived their name from *zon*, "the ſun," which was the national object of worſhip, vol. iii. p. 463. It has indeed been controverted even among ancient writers, whether ever there really was ſuch a nation as that of the Amazons. Strabo, Palæphatus, and others, deny it. On the contrary, Herodotus, Pauſanias, Diodorus Siculus, Trogus Pompeius, Juſtin, Pliny, Mela, Plutarch, &c. expreſsly aſſert it.

M. Petit, a French phyſician, publiſhed a Latin diſſertation in 1685, to prove that there was really a nation of Amazons. It contains abundance of curious inquiries relating to their habit, their arms, the cities built by them, &c. Others of the moderns alſo maintain, that their exiſtence is ſufficiently proved by the teſtimony of ſuch of the hiſtorians of antiquity as are moſt worthy of credit; by the monuments which many of them have mentioned; and by medals, ſome of which are ſtill remaining; and that there is not the leaſt room to believe that what is ſaid of them is fabulous.

The Amazons are mentioned by the moſt ancient of the Greek writers. In the third book of the Iliad, Homer repreſents Priam ſpeaking of himſelf as having been preſent, in the earlier part of his life, in a battle with the Amazons; and ſome of them afterwards came to the aſſiſtance of that prince during the ſiege of Troy.

The Amazons are particularly mentioned by Herodotus. That hiſtorian informs us, that the Grecians fought a battle with the Amazons on the river Thermodoon, and defeated them. After their victory, they carried off all the Amazons they could take alive in three ſhips. But whilſt they were out at ſea, theſe Amazons conſpired againſt the men, and killed them all. Having, however, no knowledge of navigation, nor any ſkill in the uſe of the rudder, ſails, or oars, they were driven by wind and tide till they arrived at the precipices of the lake Mæotis, in the territories of the Scythians. Here the Amazons went aſhore, and, marching into the country, ſeized and mounted the firſt horſes they met with, and began to plunder the inhabitants. The Scythians at firſt conceived them to be men; but after they had had ſkirmiſhes with them, and taken ſome priſoners, they diſcovered them to be women. They were then unwilling to carry on hoſtilities againſt them; and by degrees a number of the young Scythians formed connexions with them, and were deſirous that theſe gentle dames ſhould live with them as wives, and be incorporated with the reſt of the Scythians. The Amazons agreed to continue their connexion with their Scythian huſbands, but refuſed to aſſociate with the reſt of the inhabitants of the country, and eſpecially with the women of it. They afterwards prevailed upon their huſbands to retire to Sarmatia, where they ſettled. "Hence," ſays Herodotus, "the wives of the Sarmatians ſtill continue their ancient way of living. They hunt on horſeback in the company of their huſbands, and ſometimes alone. They march with their armies, and wear the ſame dreſs with the men. The Sarmatians uſe the Scythian language, but corrupted from the beginning, becauſe the Amazons never learned to ſpeak correctly. Their marriages are attended with this circumſtance: no virgin is permitted to marry till ſhe has killed an enemy in the field; ſo that ſome always grow old before they can qualify themſelves as the law requires."

Diodorus Siculus ſays, "There was formerly a nation who dwelt near the river Thermodoon, which was ſubjected to the government of women, and in which the women, like men, managed all the military affairs. Among theſe female warriors, it is ſaid, was one who excelled the reſt in ſtrength and valour. She aſſembled together an army of women, whom ſhe trained up in military diſcipline, and ſubdued ſome of the neighbouring nations. Afterwards, having by her valour increaſed her fame, ſhe led her army againſt the reſt; and being ſucceſsful, ſhe was ſo puffed up, that ſhe ſtyled herſelf the daughter of Mars, and ordered the men to ſpin wool, and do the work of the women within doors. She alſo made laws, by which the women were enjoined to go to the wars, and the men to be kept at home in a ſervile ſtate, and employed in the meaneſt offices. They alſo debilitated the arms and thighs of thoſe male children who were born of them, that they might be thereby rendered unfit for war. They ſeared the right breaſts of their girls, that they might be no interruption to them in fighting: whence they derived the name of Amazons. Their queen, having become extremely eminent for ſkill and knowledge in military affairs, at length built a large city at the mouth of the river Thermodoon, and adorned it with a magnificent palace. In her enterpriſes ſhe adhered ſtrictly to military diſcipline and good order; and ſhe added to her empire all the adjoining nations, even to the river Tanais. Having performed theſe exploits, ſhe at laſt ended her days like a hero, falling in a battle, in which ſhe had fought courageouſly. She was ſucceeded in the kingdom by her daughter, who imitated the valour of her mother, and in ſome exploits excelled her. She cauſed the girls from their very infancy to be exerciſed in hunting, and to be daily trained up in military exerciſes. She inſtituted ſolemn feſtivals and ſacrifices to Mars and Diana, which were named Tauropoli. She afterwards carried her arms beyond the river Tanais, and ſubdued all the people of thoſe regions, even unto Thrace. Returning then with a great quantity of ſpoils into her own kingdom, ſhe cauſed magnificent temples to be erected to the deities before mentioned; and ſhe gained the love of her ſubjects by her mild and gentle government. She afterwards undertook an expedition againſt thoſe who were on the other ſide of the river, and ſubjected to her dominion a great part of Aſia, extending her arms as far as Syria."

Diodorus alſo mentions another race of Amazons who dwelt in Africa; and whom he ſpeaks of as being of greater antiquity than thoſe who lived near the river Thermodoon. "In the weſtern parts of Libya," Amazons.

says he, "upon the borders of those tracts that are habitable, there was anciently a nation under the government of women, and whose manners and mode of living were altogether different from ours. It was the custom of those women to manage all military affairs; and for a certain time, during which they preserved their virginity, they went out as soldiers into the field. After some years employed in this manner, when the time appointed for this purpose was expired, they associated themselves with men, in order to obtain children. But the magistracy, and all public offices, they kept entirely in their own hands. The men, as the women are with us, were employed in household affairs, submitting themselves wholly to the authority of their wives. They were not permitted to take any part in military affairs, or to have any command, or any public authority, which might have any tendency to encourage them to cast off the yoke of their wives. As soon as any child was born, it was delivered to the father, to be fed with milk, or such other food as was suitable to its age. If females were born, they seared their breasts, that they might not be burdensome to them when they grew up; for they considered them as great hinderances in fighting."

Justin represents the Amazonian republic to have taken its rise in Scythia. The Scythians had a great part of Asia under their dominion upwards of 400 years, till they were conquered by Ninus, the founder of the Assyrian empire. After his death, which happened about 1150 years before the Christian era, and that of Semiramis and their son Ninyas, Ilinus and Scolopites, princes of the royal blood of Scythia, were driven from their country by other princes, who like them aspired to the crown. They departed with their wives, children, and friends; and being followed by a great number of young people of both sexes, they passed into Asiatic Sarmatia, beyond Mount Camassus, where they formed an establishment, supplying themselves with the riches they wanted, by making incursions into the countries bordering on the Euxine sea. The people of those countries, exasperated by the incursions of their new neighbours, united, surprised, and massacred the men.

The women then resolving to revenge their death, and at the same time to provide for their own security, resolved to form a new kind of government, to choose a queen, enact laws, and maintain themselves, without men, even against the men themselves. This design was not so very surprising as at first sight appears: for the greatest number of the girls among the Scythians had been inured to the same exercises as the boys; to draw the bow, to throw the javelin, to manage other arms; to riding, hunting, and even the painful labours that seem reserved for men; and many of them, as among the Sarmatians, accompanied the men in war. Hence they had no sooner formed their resolution, than they prepared to execute it, and exercised themselves in all military operations. They soon secured the peaceable possession of the country; and not content with showing their neighbours that all their efforts to drive them thence or subdue them were ineffectual, they made war upon them, and extended their own frontiers. They had hitherto made use of the instructions and assistance of a few men that remained in the country; but finding at length that they could stand their ground, and aggrandize themselves, without them, they killed all those whom flight or chance had saved from the fury of the Sarmatians, and for ever renounced marriage, which they now considered as an unsupportable slavery. But as they could only secure the duration of their new kingdom by propagation, they made a law to go every year to the frontiers, to invite the men to come to them; to deliver themselves up to their embraces, without choice on their part, or the least attachment; and to leave them as soon as they were pregnant. All those whom age rendered fit for propagation, and were willing to serve the state by breeding girls, did not go at the same time in search of men: for in order to obtain a right to promote the multiplication of the species, they must first have contributed to its destruction; nor was any thought worthy of giving birth to children till she had killed three men.

Amazons.

If from this commerce they brought forth girls, they educated them; but with respect to the boys, if we may believe Justin, they strangled them at the moment of their birth: according to Diodorus Siculus, they twisted their legs and arms, so as to render them unfit for military exercises; but Quintus Curtius, Philostratus, and Jordarus, say, that the less savage sent them to their fathers. It is probable, that at first, when their fury against the men was carried to the greatest height, they killed the boys; that when this fury abated, and most of the mothers were filled with horror at depriving the little creatures of the lives they had just received from them, they fulfilled the first duties of a mother; but, to prevent their causing a revolution in the state, maimed them in such a manner as to render them incapable of war, and employed them in the mean offices which these warlike women thought beneath them. In short, that, when their conquests had confirmed their power, their ferocity subsiding, they entered into political engagements with their neighbours; and the number of the males they had preserved becoming burdensome, they, at the desire of those who rendered them pregnant, sent them the boys, and continued still to keep the girls.

As soon as the age of the girls permitted, they took away the right breast, that they might draw the bow with the greater force. The common opinion is, that they burnt that breast, by applying to it, at eight years of age, a hot brazen instrument, which insensibly dried up the fibres and glands; some think that they did not make use of so much ceremony, but that when the part was formed they got rid of it by amputation: some again, with much greater probability, assert, that they employed no violent measures; but, by a continual compression of that part from infancy, prevented its growth, at least so far as to hinder its ever being incommodious in war.

Plutarch, treating of the Amazons in his life of Theseus, considers the accounts which had been preserved concerning them as partly fabulous and partly true. He gives some account of a battle which had been fought between the Athenians and the Amazons at Athens; and he relates some particulars of this battle which had been recorded by an ancient writer named Clidemus. He says, "That the left wing of the Amazons moved towards the place which is yet called Amazonium, and the right to a place called Pryx, near Chrysa; upon which the Athenians, issuing from behind

Amazons. hind the temple of the Muses, fell upon them; and that this is true, the graves of those that were slain, to be seen in the streets that lead to the gate Piraica, by the temple of the hero Chalcodue, are a sufficient proof. And here it was that the Athenians were routed, and shamefully turned their backs to women, as far as to the temple of the Furies. But fresh supplies coming in from Palladium, Ardettus, and Lyceum, charged their right wing, and beat them back into their very tents; in which action a great number of the Amazons were slain." In another place he says, "It appears that the passage of the Amazons through Thessaly was not without opposition; for there are yet to be seen many of their sepulchres near Scotussæa and Cynocephalæ." And in his life of Pompey, speaking of the Amazons, Plutarch says, "They inhabit those parts of Mount Caucasus that look towards the Hyrcanian sea (not bordering upon the Albanians, for the territories of the Getæ and the Lesgæ lie betwixt): and with these people do they yearly, for two months only, accompany and cohabit, bed and board, near the river Thermodoon. After that they retire to their own habitations, and live alone all the rest of the year."

Quintus Curtius says, "The nation of the Amazons is situated upon the borders of Hyrcania, inhabiting the plains of Thermiscyra, near the river Thermodoon. Their queen was named Thalestris, and she had under her subjection all the country that lies between Mount Caucasus and the river Phasis. This queen came out of her dominions, in consequence of an ardent desire she had conceived to see Alexander; and being advanced near the place where he was, she previously sent messengers to acquaint him, that the queen was come to have the satisfaction of seeing and conversing with him. Having obtained permission to visit him, she advanced with 300 of her Amazons, leaving the rest of her troops behind. As soon as she came within sight of the king, she leaped from her horse, holding two javelins in her right hand. The apparel of the Amazons does not cover all the body, for their left side is naked down to the stomach; nor do the skirts of their garments, which they tie up in a knot, reach below their knees. They preserve their left breast entire, that they may be able to suckle their female offspring; and they cut off and sear their right, that they may draw their bows, and cast their darts, with the greater ease. Thalestris looked at the king with an undaunted countenance, and narrowly examined his person; which did not according to her ideas, come up to the fame of his great exploits: For the barbarians have a great veneration for a majestic person, esteeming those only to be capable of performing great actions on whom nature has conferred a dignified appearance. The king having asked her whether she had any thing to desire of him, she replied, without scruple or hesitation, that she was come with a view to have children by him, she being worthy to bring him heirs to his dominions. Their offspring, if of the female sex, she would retain herself; and if of the male sex, it should be delivered to Alexander. He then asked her, whether she would accompany him in his wars? But this she declined, alleging, That she had left nobody to take care of her kingdom. She continued to solicit Alexander, that he would not send her back without conforming to her wishes; but it was not till after a delay of 13 days that he complied. She then returned to her own kingdom." Amazons.

Justin also repeatedly mentions this visit of Thalestris to Alexander; and in one place he says, that she made a march of 25 days, in order to obtain this meeting with him. The interview between Alexander and Thalestris is likewise mentioned by Diodorus Siculus. The learned Goropius, as he is quoted by Dr Petit, laments, in very pathetic terms, the hard fate of Thalestris, who was obliged to travel so many miles, and to encounter many hardships, in order to procure this interview with the Macedonian prince; and, from the circumstances, is led to consider the whole account as incredible. But Dr Petit, with equal erudition, with equal eloquence, and with superior force of reasoning, at length determines, that her journey was not founded upon irrational principles, and that full credit is due to those grave and venerable historians by whom this transaction has been recorded.

The Amazons are represented as being armed with bows and arrows, with javelins, and also with an axe of a particular construction, which was denominated the axe of the Amazons. According to the elder Pliny, this axe was invented by Penthesilea, one of their queens. On many ancient medals are representations of the Amazons, armed with these axes. They are also said to have had bucklers in the shape of a half moon.

The Amazons are mentioned by many other ancient authors, besides those which have been enumerated; and if any credit be due to the accounts concerning them, they subsisted through several ages. They are represented as having rendered themselves extremely formidable; as having founded cities, enlarged the boundaries of their dominions, and conquered several other nations.

That at any period there should have been women, who, without the assistance of men, built cities and governed them, raised armies and commanded them, administered public affairs, and extended their dominion by arms, is undoubtedly so contrary to all that we have seen and known of human affairs, as to appear in a very great degree incredible; but that women may have existed sufficiently robust, and sufficiently courageous, to have engaged in warlike enterprises, and even to have been successful in them, is certainly not impossible, however contrary to the usual course of things. In support of this side of the question, it may be urged, that women who have been early trained to warlike exercises, to hunting, and to a hard and laborious mode of living, may be rendered more strong, and capable of more vigorous exertions, than men who have led indolent, delicate, and luxurious lives, and who have seldom been exposed even to the inclemencies of the weather. The limbs of women, as well as of men, are strengthened and rendered more robust by frequent and laborious exercise. A nation of women, therefore, brought up and disciplined as the ancient Amazons are represented to have been, would be superior to an equal number of effeminate men, though they might be much inferior to an equal number of hardy men, trained up and disciplined in the same manner.

That much of what is said of the Amazons is fabulous, there can be no reasonable doubt; but it does not

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therefore follow, that the whole is without foundation. The ancient medals and monuments on which they are represented are very numerous, as are also the testimonies of ancient writers. It seems not rational to suppose that all this originated in fiction, though it may be much blended with it. The Abbé Guyon speaks of the history of the Amazons as having been regarded by many persons as fabulous, "rather from prejudice than from any real and solid examination;" and it must be acknowledged, that the arguments in favour of their existence, from ancient history, and from ancient monuments, are extremely powerful. The fact seems to be, that truth and fiction have been blended in the narrations concerning these ancient heroines.

Instances of heroism in women have occasionally occurred in modern times, somewhat resembling that of the ancient Amazons. The times and the manners of chivalry, in particular, by bringing great enterprises, bold adventurers, and extravagant heroism, into fashion, inspired the women with the same taste. The women, in consequence of the prevailing passion, were now seen in the middle of camps and of armies. They quitted the soft and tender inclinations, and the delicate offices of their own sex, for the toils and the toilsome occupations of ours. During the crusades, animated by the double enthusiasm of religion and of valour, they often performed the most romantic exploits; obtained indulgencies on the field of battle, and died with arms in their hands, by the side of their lovers or of their husbands.

In Europe, the women attacked and defended fortifications; princesses commanded their armies, and obtained victories. Such was the celebrated Joan de Montfort, disputing for her duchy of Bretagne, and fighting herself. Such was that still more celebrated Margaret of Anjou, that active and intrepid general and soldier, whose genius supported a long time a feeble husband; which taught him to conquer; which replaced him upon the throne; which twice relieved him from prison; and, oppressed by fortune and by rebels, which did not bend till after she had decided in person twelve battles.

The warlike spirit among the women, consistent with ages of barbarism, when every thing is impetuous because nothing is fixed, and when all excess is the excess of force, continued in Europe upwards of 400 years, showing itself from time to time, and always in the middle of convulsions, or on the eve of great revolutions. But there were eras and countries in which that spirit appeared with particular lustre. Such were the displays it made in the 15th and 16th centuries in Hungary, and in the islands of the Archipelago and the Mediterranean, when they were invaded by the Turks.

Among the striking instances of Amazonian conduct in modern ladies, may be mentioned that of Jane of Belleville, widow of Monf. de Clisson, who was beheaded at Paris in the year 1343, on a suspicion of carrying on a correspondence with England and the count de Montfort. This lady, filled with grief for the death of her late husband, and exasperated at the ill treatment which she considered him as having received, sent off "her son secretly to London; and when her apprehensions were removed with respect to him, she sold her jewels, fitted out three ships, and put to sea, to revenge the death of her husband upon all the French with whom she should meet. This new corsair made several descents upon Normandy, where she stormed castles; and the inhabitants of that province were spectators more than once, whilst their villages were all in a blaze, of one of the finest women in Europe, with a sword in one hand and a torch in the other, urging the carnage, and eyeing with pleasure all the horrors of war."

We read in Mezeray (under the article of the Croisade, preached by St Bernard in the year 1147), "That many women did not content themselves with taking the cross, but that they also took up arms to defend it, and composed squadrons of females, which rendered credible all that has been said of the prowess of the Amazons."

In the year 1590, the League party obtained some troops from the king of Spain. Upon the news of their being disembarked, Barri de St Aunez, Henry IV.'s governor at Leucate, set out to communicate a scheme to the duke de Montmorenci, commander in that province. He was taken in his way by some of the troops of the League, who were also upon their march with the Spaniards towards Leucate. They were persuaded, that by thus having the governor in their hands, the gates of that place would be immediately opened to them, or at least would not hold out long. But Constantia de Cecelli, his wife, after having assembled the garrison, put herself so resolutely at their head, pike in hand, that she inspired the weakest with courage; and the besiegers were repulsed whereever they presented themselves. Shame, and their great loss, having rendered them desperate, they sent a messenger to this courageous woman, acquainting her, that if she continued to defend herself, they would hang her husband. She replied, with tears in her eyes, "I have riches in abundance: I have offered them, and I do still offer them, for his ransom; but I would not ignominiously purchase a life which he would reproach me with, and which he would be ashamed to enjoy. I will not dishonour him by treason against my king and country." The besiegers having made a fresh attack without success, put her husband to death, and raised the siege. Henry IV. afterwards sent to this lady the brevet of governess of Leucate, with the reversion for her son.

The famous maid of Orleans, also, is an example known to every reader.

The Abbé Arnaud, in his memoirs, speaks of a countess of St Balmont, who used to take the field with her husband, and fight by his side. She sent several Spanish prisoners of her taking to Marshal Feuquiers; and, what was not a little extraordinary, this Amazon at home was all affability and sweetness, and gave herself up to reading and acts of piety.

Dr Johnson seems to have given some credit to the accounts which have been transmitted down to us concerning the ancient Amazons; and he has endeavoured to show, that we ought not hastily to reject ancient historical narrations because they contain facts repugnant to modern manners, and exhibit scenes to which nothing now occurring bears a resemblance. "Of what we know not (says he) we can only judge by what we know. Every novelty appears more wonderful, as it is more remote from any thing with which experience or testimony have hitherto acquainted us; and, if it passes farther, beyond the notions that we have been accustomed to form, it becomes at last incredible. We seldom consider that human knowledge is very narrow; that national manners are formed by chance; that uncommon conjunctures of causes produce rare effects; or, that what is impossible at one time or place may yet happen in another. It is always easier to deny than to inquire. To refuse credit confers for a moment an appearance of superiority which every little mind is tempted to assume, when it may be gained so cheaply as by withdrawing attention from evidence, and declining the fatigue of comparing probabilities. Many relations of travellers have been slighted as fabulous, till more frequent voyages have confirmed their veracity; and it may reasonably be imagined that many ancient historians are unjustly suspected of falsehood, because our own times afford nothing that resembles what they tell. Few narratives will, either to men or women appear more incredible than the histories of the Amazons; of female nations, of whose constitution it was the essential and fundamental law, to exclude men from all participation, either of public affairs or domestic business; where female armies marched under female captains, female farmers gathered the harvest, female partners danced together, and female wits diverted one another. Yet several ages of antiquity have transmitted accounts of the Amazons of Caucasus; and of the Amazons of America, who have given their name to the greatest river in the world, Condamine lately found such memorials as can be expected among erratic and unlettered nations, where events are recorded only by tradition, and new swarms settling in the country from time to time confuse and efface all traces of former times.

No author has taken so much pains upon this subject as Dr Petit. But, in the course of his work, he has given it as his opinion, that there is great difficulty in governing the women even at present, though they are unarmed and unpractised in the art of war. After all his elaborate inquiries and discussions, therefore, this learned writer might probably think, that it is not an evil of the first magnitude that the race of Amazons now ceases to exist.

Rousseau says, "The empire of the woman is an empire of softness, of address, of complacency. Her commands are caresses, her menaces are tears." But the empire of the Amazons was certainly an empire of a very different kind. Upon the whole, we may conclude with Dr Johnson: "The character of the ancient Amazons was rather terrible than lovely. The hand could not be very delicate that was only employed in drawing the bow, and brandishing the battleaxe. Their power was maintained by cruelty, their courage was deformed by ferocity; and their example only shows, that men and women live best together."

AMAZONS, *the river of*, in America. See AMAZONIA.

AMAZONIAN Habit, in *Antiquity*, denotes a dress formed in imitation of the Amazons. Marcia the famous concubine of the emperor Commodus, had the appellation of *Amazonian*, because she charmed him most in a habit of this kind. Hence also that prince himself engaged in combat in the amphitheatre in an Amazonian habit; and of all titles the *Amazonius* was one of those he most delighted in. In honour either of the gallant or his mistress, the month December was also denominated *Amazonius*. Some also apply *Amazonian* habit to the hunting-dress worn by many ladies among us.

AMBA, an Abyssinian or Ethiopic word, signifying a *rock*. The Abyssinians give names to each of their rocks, as *Amba-Dorho*, the rock of a hen, &c. Some of these rocks are said to have the name of *Aorni;* and are of such a stupendous height, that the Alps and Pyrenees are but low hills in comparison of them. Amongst the mountains, and even frequently in the plains, of this country, arise steep and craggy rocks of various forms, some resembling towers, others pyramids, &c. so perpendicular and smooth on the sides, that they seem to be works of art; insomuch, that men, cattle, &c. are craned up by the help of ladders and ropes: and yet the tops of these rocks are covered with woods, meadows, fountains, fish-ponds, &c. which very copiously supply the animals seated thereon with all the conveniencies of life. The most remarkable of these rocks is called *Amba-Geshen*. It is prodigiously steep, in the form of a castle built of freestone, and almost impregnable. Its summit is about half a Portuguese league in breadth, and the circumference at the bottom about half a day's journey. The ascent at first is easy; but grows afterwards so steep, that the Abassine oxen, which will otherwise clamber like goats, must be craned up, and let down with ropes. Here the princes of the blood were formerly confined, in low cottages amongst shrubs and wild cedars, with an allowance barely sufficient to keep them alive. There is, according to Kircher, in this country, a rock so curiously hollowed by nature, that at a distance it resembles a looking-glass; and opposite to this another, on the top of which nothing can be so softly whispered but it may be heard a great way off. Between many of these rocks and mountains are vast abysses, which appear very dreadful to the eye.

AMBACHT, is a word which denotes a kind of jurisdiction or territory, the possessor whereof has the administration of justice, both in *alto* and *basso;* or of what is called, in the Scots law, *a power of pit and gallows*, i. e. a power of drowning and hanging. In some ancient writers, ambacht is particularly used for the jurisdiction, government, or chief magistracy of a city. The word is very ancient, though used originally in a sense somewhat different. Ennius calls a mercenary, or slave hired for money, *ambactus;* and Cæsar gives the same appellation to a kind of dependents among the Gauls, who, without being slaves, were attached to the service of great lords.

AMBAGES. See CIRCUMLOCUTION.

AMBARVALIA, in *Antiquity*, a ceremony among the Romans, when, in order to procure from the gods a happy harvest, they conducted the victims thrice round the corn fields in procession, before sacrificing them.—*Ambarvalia* were either of a private or public nature: the private were performed by the master of a family, and the public by the priests who officiated at the solemnity, called *fratres ovales*. The prayer preferred on this occasion, the formula of which we have in Cato *de Re Rustica*, cap. cxlii. was called *carmen ambervale*. At these feasts they sacrificed to Ceres a sow, a sheep, and a bull or heifer, whence they took the

Ambassador ‖ Amber. the name of *ſuovetaurilia*. The method of celebrating them was, to lead a victim round the fields, while the peaſants accompanied it, and one of their number, crowned with oak, hymned forth the praiſes of Ceres, in verſes compoſed on purpoſe. This feſtival was celebrated twice a-year; at the end of January, according to ſome, or in April, according to others; and for the ſecond time, in the month of July.

AMBASSADOR, or EMBASSADOR, a public miniſter ſent from one ſovereign prince, as a repreſentative of his perſon, to another.

Ambaſſadors are either ordinary or extraordinary. Ambaſſador *in ordinary*, is he who conſtantly reſides in the court of another prince, to maintain a good underſtanding, and look to the intereſt of his maſter. Till about two hundred years ago, ambaſſadors in ordinary were not heard of: all, till then, were ambaſſadors *extraordinary*; that is, ſuch as are ſent on ſome particular occaſion, and who retire as ſoon as the affair is deſpatched.

By the law of nations, none under the quality of a ſovereign prince can ſend or receive an ambaſſador. At Athens, ambaſſadors mounted the pulpit of the public orators, and there opened their commiſſion, acquainting the people with their errand. At Rome, they were introduced to the ſenate, and delivered their commiſſions to the fathers.

Ambaſſadors ſhould never attend any public ſolemnities, as marriages, funerals, &c. unleſs their maſters have ſome intereſt therein: nor muſt they go into mourning on any occaſions of their own, becauſe they repreſent the perſon of their prince. By the civil law, the moveable goods of an ambaſſador, which are accounted an acceſſion to his perſon, cannot be ſeized on, neither as a pledge, nor for payment of a debt, nor by order or execution of judgment, nor by the king's or ſtate's leave where he reſides, as ſome conceive; for all actions ought to be far from an ambaſſador, as well that which toucheth his neceſſaries, as his perſon: if therefore, he hath contracted any debt, he is to be called upon kindly; and if he refuſes, then letters of requeſt are to go to his maſter. Nor can any of the ambaſſador's domeſtic ſervants that are regiſtered in the ſecretaries of ſtate's office be arreſted in perſon or goods; if they are, the proceſs ſhall be void, and the parties ſuing out and executing it ſhall ſuffer and be liable to ſuch penalties and corporal puniſhment as the lord chancellor or either of the chief juſtices ſhall think fit to inflict. Yet ambaſſadors cannot be defended when they commit any thing againſt that ſtate, or the perſon of the prince, with whom they reſide; and if they are guilty of treaſon, felony, &c. or any other crime againſt the law of nations, they loſe the privilege of an ambaſſador, and may be ſubject to puniſhment as private aliens.

AMBE, in *Surgery*, the name of an inſtrument for reducing diſlocated bones. In *Anatomy*, a term for the ſuperficial jutting out of a bone.

AMBER (*Succinum*), in *Natural Hiſtory*, a ſolid, hard, ſemipellucid, bituminous ſubſtance of a particular nature, of uſe in medicine and in ſeveral of the arts. It has been called *ambra* by the Arabians, and *electrum* by the Greeks.

Amber has been of great repute in the world from the earlieſt times. Many years before Chriſt it was in eſteem as a medicine; and Plato, Ariſtotle, Herodotus, Æſchylus, and others, have commended its virtues. In the times of the Romans, it became in high eſteem as a gem; and in the luxurious reign of Nero, immenſe quantities of it were brought to Rome, and uſed for ornamenting works of various kinds.

Amber.

The moſt remarkable property of this ſubſtance is, that when rubbed it draws or attracts other bodies to it: and this, it is obſerved, it does even to thoſe ſubſtances which the ancients thought it had an antipathy to; as oily bodies, drops of water, human ſweat, &c. Add, that, by the friction it is brought to yield light pretty copiouſly in the dark; whence it is reckoned among the native phoſphori.

The property which amber poſſeſſes of attracting light bodies was very anciently obſerved. Thales of Miletus, 600 years before Chriſt, concluded from hence, that it was animated. But the firſt perſon who expreſsly mentions this ſubſtance is Theophraſtus, about the year 300 before Chriſt. The attractive property of amber is likewiſe occaſionally taken notice of by Pliny and other later naturaliſts, particularly by Gaſſendus, Kenelm Digby, and Sir Thomas Brown; but it was generally apprehended that this quality was peculiar to amber and jet, and perhaps agate, till Gilbert publiſhed his treatiſe *de Magnete*, in the year 1600. From εληκτρον, the Greek name for amber, is derived the term *Electricity*, which is now very extenſively applied, not only to the power of attracting light bodies inherent in amber, but to other ſimilar powers, and their various effects in whatever bodies they reſide, or to whatever bodies they may be communicated.

Amber aſſumes all figures in the ground; that of a pear, an almond, a pea, &c. In amber there have been ſaid to be letters found very well formed; and even Hebrew and Arabic characters.—Within ſome pieces, leaves, inſects, &c. have likewiſe been found included; which ſeems to indicate either that the amber was originally in a fluid ſtate, or that having been expoſed to the ſun it was once ſoftened, and rendered ſuſceptible of the leaves, inſects, &c. which came in its way. The latter of theſe ſuppoſitions ſeems the more agreeable to the phenomenon; becauſe thoſe inſects, &c. are never found in the centre of the pieces of amber, but always near the ſurface. It is obſerved by the inhabitants of thoſe places where amber is produced, that all animals, whether terreſtrial, aerial, or aquatic, are extremely fond of it, and that pieces of it are frequently found in their excrements. The bodies of inſects, found buried in amber, are viewed with admiration by all the world; but of the moſt remarkable of theſe, many are to be ſuſpected as counterfeit, the great price at which beautiful ſpecimens of this kind ſell, having tempted ingenious cheats to introduce animal bodies in ſuch artful manners, into ſeemingly whole pieces of amber, that it is not eaſy to detect the fraud.

Of thoſe inſects which have been originally encloſed in amber, ſome are plainly ſeen to have ſtruggled hard for their liberty, and even to have left their limbs behind them in the attempt; it being no unuſual thing to ſee, in a maſs of amber that contains a ſtout beetle, the animal wanting one, or perhaps two of its legs; and thoſe legs left in different places, nearer that part of the maſs from which it has travelled. This alſo may account for the common accident of finding legs or or wings of flies, without the rest of their bodies, in pieces of amber; the insects having, when entangled in the yet soft and viscid matter, escaped, at the expence of leaving those limbs behind them. Drops of clear water are sometimes also preserved in amber. These have doubtless been received into it while soft, and preserved by its hardening round them. Beautiful leaves of a pinnated structure, resembling some of the ferns, or maidenhairs, have been found in some pieces; but these are rare, and the specimens of great value. Mineral substances are also found at times lodged in masses of amber. Some of the pompous collections of the German princes boast of specimens of native gold and silver in masses of amber; but as there are many substances of the marcasite, and other kinds, that have all the glittering appearance of gold and silver, it is not to be too hastily concluded, that these metals are really lodged in these beds of amber. Iron is found in various shapes immersed in amber; and as it is often seen eroded, and sometimes in the state of vitriol, it is not impossible but that copper, and the other metals, may be also sometimes immersed in it in the same state; hence the bluish and greenish colours, frequently found in the recent pieces of amber, may be owing, like the particles of the gem colours, to those metals; but as the gems, by their dense texture, always retain their colours, this lighter and more lax bitumen usually loses what it gets of this kind by keeping some time. Small pebbles, grains of sand, and fragments of other stones, are also not unfrequently found immersed in amber.

Naturalists have been greatly divided as to the origin of this substance, and what class of bodies it belongs to; some referring it to the vegetable, others to the mineral, and some even to the animal kingdom. Pliny describes it as "a resinous juice, oozing from aged pines and firs (others say from poplars, whereof there are whole forests on the coasts of Sweden), and discharged thence into the sea, where undergoing some alteration, it is thrown, in this form, upon the shores of Prussia, which lie very low: he adds, that it was hence the ancients gave it the denomination *succinum;* from *succus*, juice.

Some suppose amber a compound substance. Prussia, say they, and the other countries which produce amber, are moistened with a bituminous juice, which mixing with the vitriolic salts abounding in those places, the points of those salts fix its fluidity, whence it congeals; and the result of that congelation makes what we call amber; which is more or less pure, transparent, and firm, as those parts of salt and bitumen are more or less pure, and are mixed in this or that proportion.

Mr Brydone, in his tour to Sicily and Malta, says, that the river Gearetta, formerly celebrated by the poets under the name of Simetus, throws up near its mouth great quantities of amber. He mentions also a kind of artificial amber, not uncommon there, made, as he was told, from copal, but very different from the natural.

According to Hartman, amber is formed of a bitumen, mixed with vitriol and other salts. But though this were allowed him in regard to the fossil amber, many dispute whether the sea amber be so produced. It is, however, apparent, that all amber is of the same origin, and probably that which is found in the sea has been washed thither out of the cliffs; though Hartman thinks it very possible, that some of it may be formed in the earth under the sea, and be washed up thence. The sea amber is usually finer to the eye than the fossil; but the reason is, that it is divested of that coarse coat with which the other is covered while in the earth.

Upon the whole, it seems generally agreed upon, that amber is a true bitumen of a fossil origin. In a late volume of the *Journal de Physique*, however, we find it asserted by Dr Girtanner to be an animal product, a sort of honey or wax formed by a species of large ant called by Linnæus *formica rufa*. These ants, our author informs us, inhabit the old pine forests, where they sometimes form hills about six feet in diameter: and it is generally in these ancient forests, or in places where they have been, that fossil amber is found. This substance is not hard as that which is taken up in the sea at Prussia, and which is well known to naturalists. It has the consistence of honey or of half melted wax, but it is of a yellow colour like common amber; it gives the same product by chemical analysis, and it hardens like the other when it is suffered to remain some time in a solution of common salt. This accounts for the insects that are so often found inclosed in it. Among these insects ants are always the most prevailing; which tends farther, Mr Girtanner thinks, to the confirmation of his hypothesis. Amber, then, in his opinion, is nothing but a vegetable oil rendered concrete by the acid of ants, just as wax is nothing but an oil hardened by the acid of bees; a fact incontestably proved, we are told, since Mr Metherie has been able to make artificial wax by mixing oil of olives with the nitrous acid, and which wax is not to be distinguished from the natural.

There are several indications which discover where amber is to be found. The surface of the earth is there covered with a soft scaly stone; and vitriol in particular always abounds there, which is sometimes found white, sometimes reduced into a matter like melted glass, and sometimes figured like petrified wood.

Amber of the finest kind has been found in England. It is frequently thrown on the shores of Yorkshire, and many other places, and found even in our clay pits; the pits dug for tile-clay between Tyburn and Kensington gravel pits, and that behind St George's Hospital at Hyde-park corner, have afforded fine specimens.

Poland, Silesia, and Bohemia, are famous for the amber dug up there at this time. Germany affords great quantities of amber, as well dug up from the bowels of the earth, as tossed about on the shores of the sea and rivers there. Saxony, Misnia, Sweden, and many other places in this tract of Europe, abound with it. Denmark has afforded, at different times, several quantities of fossil amber; and the shores of the Baltic abound with it. But the countries lying on the Baltic afford it in the greatest abundance of all; and of these the most plentiful country is Prussia, and the next is Pomerania. Prussia was, as early as the time of Theodoric the Goth, famous for amber; for this substance coming into great repute with this prince, some natives of Prussia, who were about his court, offered their service to go to their own country, where that

Amber.

that substance, they said, was produced, and bring back great stores of it. They accordingly did so; and from this time Prussia had the honour to be called the country of amber, instead of Italy, which had before undeservedly that title. This article alone brings his Prussian majesty a revenue of 26,000 dollars annually. The amber of Prussia is not only found on the sea coasts, but in digging; and though that of Pomerania is generally brought from the shores, yet people who dig, on different occasions, in the very heart of the country, at times find amber.

Junker describes, after Neumann, the Prussian amber mines, which are the richest known. First, At the surface of the earth is found a stratum of sand. Immediately under this sand is a bed of clay, filled with small flints of about an inch diameter each. Under this clay lies a stratum of black earth or turf, filled with fossil wood, half decomposed and bituminous: this stratum is extended upon a bank of minerals, containing little metal except iron, which are consequently pyrites. Lastly, Under this bed the amber is found scattered about in pieces, or sometimes accumulated in heaps.

Amber has a subacrid resinous taste, and fragrant aromatic smell, especially when dissolved. It differs from the other bituminous substances in this, that it yields by distillation a volatile acid salt, which none of the others do; otherwise it affords the same sort of principles as them, viz. an acid phlegm, an oil which gradually becomes thicker as the distillation is continued; and when the operation is finished, there remains a black caput mortuum in the retort. When boiled in water, it neither softens nor undergoes any sensible alteration. Exposed to the fire in an open vessel, it melts into a black mass very like a bitumen: It is partly soluble in spirit of wine, and likewise in some essential oils; but it is with difficulty that the expressed ones are brought to act upon it. The stronger sorts of fixed alkaline lixivia almost totally dissolve it.

This substance is principally of two colours, white and yellow. The white is the most esteemed for medicinal purposes, as being the most odoriferous, and containing the greatest quantity of volatile salt; though the yellow is most valued by those who manufacture beads and other toys with it, by reason of its transparency.

Amber is the basis of all varnishes, by solution in the ways described under the article Varnish.

Amber, when it has once been melted, irrecoverably loses its beauty and hardness. There have been some, however, who pretended they had an art of melting some small pieces of amber into a mass, and constituting large ones of them: but this seems such another undertaking as the making of gold; all the trials that have yet been made by the most curious experimenters, proving, that the heat which is necessary to melt amber is sufficient to destroy it. (*Phil. Trans.* N° 248. p. 25.)

Could amber indeed be dissolved without impairing its transparency, or one large mass be made of it by uniting several small ones, it is easy to see what would be the advantages of such a process. The art of embalming might possibly be also carried to a great height by this, if we could preserve the human corpse in a transparent case of amber, as the bodies of flies, spiders, grashoppers, &c. are to a great perfection.— Something of a substitute of this kind we have in fine rosin; which being dissolved by heat, and the bodies of small animals several times dipped in it, they are thus coated with colophony, that in some degree resembles amber; but this must be kept from dust.

Amber-tree || Ambergris.

Amber in substance has been much recommended as a nervous and cordial medicine; and alleged to be very efficacious in promoting the menstrual discharge, and the exclusion of the fœtus and secundines in labour: but as in its crude state it is quite insoluble by our juices, it certainly can have very little effect on the animal system, and therefore it is now seldom given in substance. The forms in which amber is prepared are, A tincture, a salt, and an oil; the preparations and uses of which are described in the proper place under the article Pharmacy.

Amber-Tree, the English name of a species of Anthospermum.

AMBERG, a city of Germany, the capital of the palatinate of Bavaria, with a good castle, ramparts, bastions, and deep ditches. It is seated near the confines of Franconia, on the river Wils. It has a great trade in iron and other metals, which are found in the neighbouring mountains. E. Long. 12. 0. N. Lat. 49. 25.

Amberg, a lofty mountain of East Gothland in Sweden. Near the Wetter lake on this mountain, antimony has been found. On its top is the burying place of one of the ancient kings of the country. The spot is marked by a flat stone.

AMBERGRIS, Ambergrease, or Grey-Amber, in *Natural History*, is a solid, opaque, ash-coloured, fatty, inflammable substance, variegated like marble, remarkably light, rugged, and uneven in its surface, and has a fragrant odour when heated. It does not effervesce with acids: it melts freely over the fire into a kind of yellow rosin; and is hardly soluble in spirit of wine.

It is found swimming upon the sea, or the sea coast, or in the sand near the sea coast; especially in the Atlantic ocean, on the sea coast of Brazil, and that of Madagascar; on the coast of Africa, of the East Indies, China, Japan, and the Molucca islands: but most of the ambergris which is brought to England comes from the Bahama islands, from Providence, &c. where it is found on the coast. It is also sometimes found in the abdomen of whales by the whale fishermen, always in lumps of various shapes and sizes, weighing from half an ounce to an hundred and more pounds. The piece which the Dutch East India Company bought from the king of Tydore, weighed 182 pounds. An American fisherman from Antigua found some years ago, about fifty-two leagues south-east from the Windward islands, a piece of ambergris in a whale which weighed about a hundred and thirty pounds, and sold for 500l. sterling.

There have been many different opinions concerning the origin of this substance.

It has been supposed to be a fossil bitumen or naphtha, exuding out of the bowels of the earth in a fluid form, and distilling into the sea, where it hardens and floats on the surface. But having been frequently found in the bellies of whales, it has by others been considered as entirely an animal production.

Clusius asserted it to be a phlegmatic recrement, or indurated

Ambergris. indurated indigeſtible part of the food, collected and found in the ſtomach of the whale, in the ſame manner as the Bezoars are found in the ſtomachs of other animals.

In an account communicated by Paul Dudley, Eſq. in the 23d volume of the Philoſophical Tranſactions, the ambergris found in whales is repreſented as a kind of animal product, like muſk, and caſtoreum, &c. ſecreted and collected in a particular bag or bladder, which is furniſhed with an excretory duct or canal, the ſpout of which runs tapering into and through the length of the penis; and that this bag, which lies juſt over the teſticles, is almoſt full of a deep orange-coloured liquor, not quite ſo thick as oil, of the ſame ſmell as the balls of ambergris, which float and ſwim looſe in it; which colour and liquor may alſo be found in the canal of the penis; and that therefore ambergris is never to be found in any female, but in the male only. But theſe circumſtances are not only deſtitute of truth, but alſo contrary to the laws of the animal economy: For, in the firſt place, ambergris is frequently found in females as well as males; although that found in females is never in ſuch large pieces, nor of ſo good a quality, as what is found in males. Secondly, No perſon who has the leaſt knowledge in anatomy or phyſiology, will ever believe that organized bodies, ſuch as the beaks of the ſepia, which are ſo conſtantly found in ambergris taken out of the whale, can have been abſorbed from the inteſtines by the lacteals or lymphatics, and collected with the ambergris in the precluded bag above mentioned.

Kæmpfer, who has given us ſo many other faithful accounts in natural hiſtory, ſeems to come nearer the truth with regard to the origin of ambergris, when he ſays, that it is the dung of the whale; and that the Japaneſe for this reaſon call it *kuſura no fuu*, i. e. whale's dung. This account, however, though founded on obſervation, has never obtained credit; but has been conſidered rather as a fabulous ſtory, with which the Japaneſe impoſed upon him, who had himſelf no direct obſervation to prove the fact.

This matter, therefore, remained a ſubject of great doubt; and it was generally thought to be more probable, that ambergris, after having been ſwallowed and ſomehow or other changed in the ſtomach and bowels of the whale, was found among its excrements.

But the moſt ſatisfactory account of the real origin of ambergris, is that given by Dr Swediaur in the 73d volume of the Philoſophical Tranſactions, art. 15.

We are told by all writers on ambergris, that ſometimes claws and beaks of birds, feathers of birds, parts of vegetables, ſhells, fiſh, and bones of fiſh, are found in the middle of it, or variouſly mixed with it. Of a very large quantity of pieces, however, which the Doctor examined, he found none that contained any ſuch thing; though he allows that ſuch ſubſtances may ſometimes be found in it: but in all the pieces of any conſiderable ſize, whether found on the ſea or in the whale, he conſtantly found a conſiderable quantity of black ſpots, which, after the moſt careful examination, appeared to be the beaks of the Sepia *Octopodia*; and theſe beaks, he thinks, might be the ſubſtances which have hitherto been always miſtaken for claws or beaks of birds, or for ſhells.

The preſence of theſe beaks in ambergris proves evidently, that all ambergris containing them is in its ori- Ambergris. gin, or muſt have been once, of a very ſoft or liquid nature, as otherwiſe thoſe beaks could not ſo conſtantly be intermixed with it throughout its whole ſubſtance.

That ambergris is found either upon the ſea and ſea-coaſt, or in the bowels of whales, is a matter of fact univerſally credited. But it has never been examined into and determined whether the ambergris found upon the ſea and ſea coaſt, is the ſame as that found in the whale, or whether they are different from one another; whether that found on the ſea or ſea coaſt has ſome properties or conſtituent parts which that found in the whale has not; and laſtly, whether that found in the whale is ſuperior or inferior in its qualities and value to the former.

It is likewiſe a matter of conſequence to know, whether ambergris is found in all kinds of whales, or only in a particular ſpecies of them; whether it is conſtantly and always to be met with in thoſe animals; and, if ſo, in what part of their body it is to be found?

All theſe queſtions we find very ſatisfactorily diſcuſſed by Dr Swediaur.

According to the beſt information that he could obtain from ſeveral of the moſt intelligent perſons employed in the ſpermaceti whale fiſhery, and in procuring and ſelling ambergris, it appears, that this ſubſtance is ſometimes found in the belly of the whale, but in that particular ſpecies only which is called the *ſpermaceti whale*, and which, from its deſcription and delineation, appears to be the Physeter *Macrocephalus* Linnæi.

The New England fiſhermen, according to their account, have long known that ambergris is to be found in the ſpermaceti whale; and they are ſo convinced of this fact, that whenever they hear of a place where ambergris is found, they always conclude that the ſeas in that part are frequented by that ſpecies of whale.

The perſons who are employed in the ſpermaceti whale fiſhery, confine their views to the phyſeter macrocephalus. They look for ambergris in all the ſpermaceti whales they catch, but it ſeldom happens that they find any. Whenever they hook a ſpermaceti whale, they obſerve, that it conſtantly not only vomits up whatever it has in its ſtomach, but alſo generally diſcharges its fæces at the ſame time; and if this latter circumſtance takes place, they are generally diſappointed in finding ambergris in its belly. But whenever they diſcover a ſpermaceti whale, male or female, which ſeems torpid and ſickly, they are always pretty ſure to find ambergris, as the whale in this ſtate ſeldom voids its fæces upon being hooked. They likewiſe generally meet with it in the dead ſpermaceti whales, which they ſometimes find floating on the ſea. It is obſerved alſo, that the whale in which they find ambergris often has a morbid protuberance, or, as they expreſs it, a kind of gathering in the lower part of its belly, in which, if cut open, ambergris is found. It is obſerved, that all thoſe whales in whoſe bowels ambergris is found, ſeem not only torpid and ſick, but are alſo conſtantly leaner than others; ſo that, if we may judge from the conſtant union of theſe two circumſtances, it would ſeem that a larger collection of ambergris in the belly of the whale is a ſource of diſeaſe, and probably ſometimes the cauſe of its death. As ſoon as they hook

Ambergris. hook a whale of this description, torpid, sickly, emaciated, or one that does not dung on being hooked, they immediately either cut up the above-mentioned protuberance, if there be any, or they rip open its bowels from the orifice of the anus, and find the ambergris sometimes in one sometimes in different lumps, of generally from three to twelve and more inches in diameter, and from one pound to twenty or thirty pounds in weight, at the distance of two, but most frequently of about six or seven feet from the anus, and never higher up in the intestinal canal; which, according to their description, is in all probability the intestinum cæcum, hitherto mistaken for a peculiar bag made by nature for the secretion and collection of this singular substance. That the part they cut open to come at the ambergris is no other than the intestinal canal is certain, because they constantly begin their incision at the anus, and find the cavity everywhere filled with the fæces of the whale, which from their colour and smell it is impossible for them to mistake. The ambergris found in the intestinal canal is not so hard as that which is found on the sea or sea coast, but soon grows hard in the air: when first taken out it has nearly the same colour, and the same disagreeable smell, though not so strong, as the more liquid dung of the whale has; but on exposing it to the air, it by degrees not only grows grayish, and its surface is covered with a grayish dust like old chocolate, but it also loses its disagreeable smell, and, when kept for a certain length of time, acquires the peculiar odour which is so agreeable to most people.

The gentlemen the Doctor conversed with confessed, that if they knew not from experience that ambergris thus found will in time acquire the above-mentioned qualities, they would by no means be able to distinguish ambergris from hard indurated fæces. This is so true, that whenever a whale voids its fæces upon being hooked, they look carefully to see if they cannot discover among the more liquid excrements (of which the whale discharges several barrels) some pieces floating on the sea, of a more compact substance than the rest. These they take up and wash, knowing them to be ambergris.

In considering whether there be any material difference between the ambergris found upon the sea or sea coast, and that found in the bowels or among the dung of the whale, the Doctor refutes the opinion, that all ambergris found in whales is of an inferior quality, and therefore much less in price. Ambergris, he observes, is only valued for its purity, lightness, compactness, colour, and smell. There are pieces of ambergris found on different coasts, which are of a very inferior quality; whereas there are often found in whales pieces of it of the first value; nay, several pieces found in the same whale, according to the above-mentioned qualities, are more or less valuable. All ambergris found in whales has at first, when taken out of the intestines, very near the same smell as the liquid excrements of that animal have; it has then also nearly the same blackish colour: they find it in the whale sometimes quite hard, sometimes rather softish, but never so liquid as the natural fæces of that animal. And it is a matter of fact, that after being taken out and kept in the air, all ambergris grows not only harder and whiter, but also loses by degrees its smell, and assumes such an agreeable one, as that in general has which is found swimming upon the sea; therefore the goodness of ambergris seems rather to depend on its age. By being accumulated after a certain length of time in the intestinal canal, it seems even then to become of a whiter colour, and less ponderous, and to acquire its agreeable smell. The only reason why ambergris found floating on the sea generally possesses the above-mentioned qualities in a superior degree, is because it is commonly older, and has been longer exposed to the air. It is more frequently found in males than females; the pieces found in females are in general smaller, and those found in males seem constantly to be larger and of a better quality; and therefore the high price in proportion to the size is not merely imaginary for the rarity's sake, but in some respects well founded, because such large pieces appear to be of a greater age and possess the above-mentioned qualities in general in a higher degree of perfection than smaller pieces.

It is known, that the sepia octopodia, or cuttle-fish, is the constant and natural food of the spermaceti whale, or physeter macrocephalus. Of this the fishers are so well persuaded, that whenever they discover any recent relics of it swimming on the sea, they conclude that a whale of this kind is, or has been, in that part. Another circumstance which corroborates the fact is, that the spermaceti whale on being hooked generally vomits up some remains of the sepia. Hence it is easy to account for the many beaks, or pieces of beaks, of the sepia found in all ambergris. The beak of the sepia is a black horny substance, and therefore passes undigested through the stomach into the intestinal canal, where it is mixed with the fæces; after which it is either evacuated with them, or if these latter be preternaturally retained, forms concretions with them, which render the animal sick and torpid, and produce an obstipation, which ends either in an abscess of the abdomen, as has been frequently observed, or becomes fatal to the animal; whence, in both the cases, on the bursting of its belly, that hardened substance known under the name of *ambergris*, is found swimming on the sea or thrown upon the coast.

From the preceding account, and his having constantly found the above-mentioned beaks of the sepia in all pieces of ambergris of any considerable size, Dr Swediaur concludes with great probability, that all ambergris is generated in the bowels of the physeter macrocephalus or spermaceti whale; and there mixed with the beaks of the sepia octopodia, which is the principal food of that whale. He therefore defines ambergris to be the preternaturally hardened dung or fæces of the physeter macrocephalus, mixed with some indigestible relics of its food.

The opinion of Dr Swediaur, with regard to the origin of ambergris, has been confirmed by the information of Captain J. Coffin, master of a ship employed in the southern whale fishery, given to a committee of privy council in the year 1791. According to Mr Coffin's information, American ships had sometimes found small quantities of ambergris; but none, that he knew of, had ever been found by British ships. The quantity which he had brought home amounted to 362 ounces; and it was taken from the body of a female spermaceti whale on the coast of Guinea, which was

was lean, ſickly, and old; and yielded but a ſmall proportion of oil. While the people were employed in cutting up the blubber, ambergris was diſcovered coming from the fundament of the whale, and a piece of it was ſeen floating on the ſurface of the ſea. More was obſerved in the ſame paſſage, and the reſt was found in a bag a little below the paſſage and communicating with it. Mr Coffin ſuppoſes, that the ſpermaceti whale feeds almoſt wholly on the ſepia or *ſquid;* for when the whale is dying a quantity of this fiſh, ſometimes whole, ſometimes in pieces, is thrown up. The bills of the ſquid were found, ſome on the outſide adhering to it, and ſome mixed with it. The ſpermaceti whale, when ſtruck, generally voids her excrement, and if ſhe does not, Mr Coffin conjectures, that ſhe has no ambergris; for he ſuppoſes, that the production of it is the cauſe or the effect of ſome diſorder; and that it is moſt likely to be found in a ſickly fiſh. The ambergris of the whale taken by Mr Coffin was moſtly ſold at 19s. 9d. per ounce; and a ſmall part of it, when it was ſcarce, at 25s. It was bought partly for home conſumption, and partly for exportation to Turkey, Germany, and France. (*Phil. Tranſ.* vol. lxxxi.)

The uſe of ambergris in Europe is now nearly confined to perfumery, though it has formerly been recommended in medicine by ſeveral eminent phyſicians. Hence the Eſſentia Ambræ Hoffmanni, Tinctura Regia Cod. Pariſini, Trochiſci de Ambra Ph. Wurtemberg, &c.

If we wiſh to ſee any medicinal effects from this ſubſtance, the Doctor obſerves, we muſt certainly not expect them from two or three grains, but give rather as many ſcruples of it for a doſe; though even then, he thinks, there would not be reaſon to expect much effect from it, as he had himſelf taken of pure unadulterated ambergris in powder 30 grains at once without obſerving the leaſt ſenſible effect from it. A ſailor, however, who had the curioſity to try the effect of recent ambergris upon himſelf, took half an ounce of it melted upon the fire, and found it a good purgative; which proves that it is not quite an inert ſubſtance.

In Aſia and part of Africa ambergris is not only uſed as a medicine and a perfume; but conſiderable uſe is alſo made of it in cookery, by adding it to ſeveral diſhes as a ſpice. A great quantity of it is alſo conſtantly bought by the pilgrims who travel to Mecca; probably to offer it there, and make uſe of it in fumigations, in the ſame manner as frankincenſe is uſed in Catholic countries. The Turks make uſe of it as an aphrodiſiac. Our perfumers add it to ſcented pillars, candles, balls, bottles, gloves, and hairpowder; and its eſſence is mixed with pomatums, for the face and hands, either alone or mixed with muſk, &c. though its ſmell is to ſome perſons extremely offenſive.

Ambergris may be known to be genuine by its fragrant ſcent when a hot needle or pin is thruſt into it, and its melting like fat of an uniform conſiſtence; whereas the counterfeit will not yield ſuch a ſmell, nor prove of ſuch a fat texture. One thing, however is very remarkable, that this drug, which is the moſt ſweet of all the perfumes, ſhould be capable of being reſembled in ſmell by a preparation of one of the moſt odious of all ſtinks. Mr Homberg found, that a veſſel in which he had made a long digeſtion of human fæces, acquired a very ſtrong and perfect ſmell of ambergris, inſomuch that any one would have thought a great quantity of eſſence of ambergris had been made in it. The perfume was ſo ſtrong and offenſive, that the veſſel was forced to be removed out of the laboratory.

AMBERT, a ſmall town of France, in the department of Puy de Dome, formerly Lower Auvergne. It is the chief place of a ſmall territory called *Livradois*. Paper and playing cards, camblets, and woollen ſtuffs are manufactured here. E. Long. 5. 15. N. Lat. 45. 58.

AMBETTUWAY, a barbarous name of a tree, the leaves of which, when boiled in wine, are ſaid to create an appetite, and are uſed by the people in Guinea with that intention.

AMBIANI, or AMBIANENSIS CIVITAS, now *Amiens*, a city of Picardy. It is called *Samarobriva* by Cæſar and Cicero: which, according to Valeſius, ſignifies the bridge of the *Samara*, or *Somme*. *Ambiani* is a later name, taken from that of the people, after the uſual manner of the lower age. This people, according to Cæſar, furniſhed 5000 men for the ſiege of Aleſia.

AMBIDEXTER, a perſon who can uſe both hands with the ſame facility, and for the ſame purpoſes, that the generality of people do their right hands. As to the natural cauſe of this faculty, ſome, as Hœfer, attribute it to an extraordinary ſupply of blood and ſpirits from the heart and brain, which furniſhes both hands with the neceſſary ſtrength and agility; others, as Nicholas Maſſa, to an erect ſituation of the heart, inclining neither to the right hand nor left; and others to the right and left ſubclavian arteries being of the ſame height, and the ſame diſtance from the heart, by which the blood is propelled with equal force to both hands. But theſe are only conjectures, or rather chimeras. Many think, that were it not for education and habit, all mankind would be ambidexters; and in fact, we frequently find nurſes obliged to be at a good deal of pains before they can bring children to forego the uſe of their left hands. How far it may be an advantage to be deprived of half our natural dexterity, may be doubted. It is certain, there are infinite occaſions in life, when it would be better to have the equal uſe of both hands. Surgeons and oculiſts are of neceſſity obliged to be ambidexters; bleeding, &c. in the left arm or left ancle, and operations on the left eye, cannot be well performed but with the left hand. —Various inſtances occur in hiſtory, where the left hand has been exerciſed preferably to the right. But by the laws of the ancient Scythians, people were enjoined to exerciſe both hands alike; and Plato enjoins ambidexterity to be obſerved and encouraged in his republic.

AMBIDEXTER, among *Engliſh Lawyers*, a juror or embracer, who accepts money of both parties, for giving his verdict: an offence for which he is liable to be impriſoned, for ever excluded from a jury, and to pay ten times the ſum he accepted.

AMBIENT, a term uſed for ſuch bodies, eſpecially

 fluids,

fluids, as encompass others on all sides: thus, the air is frequently called an ambient fluid, because it is diffused round the earth.

AMBIERLE, a town of France, in the department of the Rhone and Loire. It is the chief place of a canton in a district of Roanne.

AMBIGENÆ OVES, in the *Heathen Sacrifices*, an appellation given to such ewes as, having brought forth twins, were sacrificed, together with their two lambs, one on each side. We find them mentioned among other sacrifices to Juno.

AMBIGENAL HYPERBOLA, a name given by Sir Isaac Newton to one of the triple hyperbolas of the second order, having one of its infinite legs falling within an angle formed by the assymptotes, and the other without.

AMBIGUITY, a defect of language, whereby words are rendered ambiguous. See the next article.

AMBIGUOUS, a term applied to a word or expression which may be taken in different senses. An anonymous writer has published a dictionary of ambiguous words: *Lexicon Philosophicum de Ambiguitate Vocabulorum*, Francof. 1597, 4to.—The responses of the ancient oracles were always ambiguous.

AMBIT, in *Geometry*, is the same with what is otherwise called the perimeter of a figure. See PERIMETER.

AMBIT was particularly used, in antiquity, to denote a space of ground to be left vacant betwixt one building and another. By the laws of the twelve tables, houses were not to be built contiguous, but an ambit or space of 2½ feet was to be left about each for fear of fire.—The ambitus of a tomb or monument denoted a certain number of feet, in length and breadth, around the same, within which the sanctity assigned to it was limited. The whole ground wherein a tomb was erected was not to be secreted from the common uses; for this reason, it was frequent to inscribe the ambit on it, that it might be known how far its sanctity extended: thus, *in fronte pedes tot, in agrum pedes tot.*

AMBITION (*ambitio*) is generally used in a bad sense, for an immoderate or illegal pursuit of power.

In the strict meaning, however, of the word, it signifies the same with the *ambitus* of the Romans. See the next article.

Ambition, in the former and more usual sense, is one of those passions that is never to be satisfied. It swells gradually with success; and every acquisition serves but as a spur to further attempts.

"If a man (it has been well observed) could at once accomplish all his desires, he would be a miserable creature; for the chief pleasure of this life is to wish and desire. Upon this account, every prince who aspires to be despotic aspires to die of weariness. Searching every kingdom for the man who has the least comfort in life, Where is he to be found?—In the royal palace. —What! his Majesty? Yes, especially if he be despotic."

AMBITUS, in *Roman Antiquity*, the setting up for some magistracy or office, and formally going round the city to solicit the interest and votes of the people.

Ambitus differed from *ambition*, as the former lies in the act, the latter in the mind.

Ambitus was of two kinds; one lawful, the other infamous. The first, called also *ambitus popularis*, was when a person offered his service to the republic frankly, leaving it to every body to judge of his pretensions as they found reasonable. The means and instruments here made use of were various. 1. *Amici*, or friends, under different relations, including *cognati, affines, necessarii, familiares, vicini, tribules, clientes, municipes, sodales, collegæ*. 2. *Nomenclatura*, or the calling and saluting every person by his name; to which purpose, the candidates were attended by an officer, under the denomination of *interpres*, or *nomenclator*. 3. *Blanditia*, or obliging persons, by serving them, or their friends, patrons, or the like, with their vote and interest on other occasions. 4. *Prensatio*, the shaking every person by the hand, offering him his service, friendship, &c. The second kind was that wherein force, cajoling, money, or other extraordinary influence, was made use of. This was held infamous, and severely punished, as a source of corruption and other mischiefs.

Ambitus was practised, not only at Rome, and in the forum, but in the meetings and assemblies of other towns in Italy, where numbers of citizens were usually found, on account of trade and business. The practice ceased in the city from the time of the emperors, by reason posts were not then to be had by courting the people, but by favour from the prince.

Persons who had causes depending practised the same, going about among the judges to implore their favour and mercy. They who practised this were called *Ambitiosi*. Hence we also meet with *ambitiosa decreta*, and *ambitiosa justa*, used for such sentences and decrees as were thus procured from the judges, contrary to reason and equity, either gratuitously or for money.

AMBLE, in *Horsemanship*, a peculiar pace by which a horse's two legs of the same side move at the same time. See HORSEMANSHIP.

AMBLESIDE, a town in Westmorland, seated at one end of Winandermeer. W. Long. 0. 49. N. Lat. 54. 30.

AMBLETEUSE, a sea-port town of France, in the department of the Straits of Calais, in the English Channel, twelve miles south-west from Calais, and eight north from Boulogne. At this port Cæsar embarked his cavalry when he invaded England; and James II. when he abdicated the crown landed. It is defended with a battery of cannon. E. Long. 1. 37. N. Lat. 50. 48.

AMBLYGON, in *Geometry*, denotes an obtuse-angled triangle, or a triangle one of whose angles consists of more than 90 degrees.

AMBLYOPY, among *Physicians*, signifies an obscuration of the sight, so that objects at a distance cannot be clearly distinguished.

AMBO, or AMBON, a kind of pulpit or desk, in the ancient churches, where the priests and deacons stood to read or sing part of the service, and preach to the people; called also *Analogium*. The term is derived from αναβαινειν, "to mount." The ambo was mounted upon two sides; whence some also derive the appellation from the Latin *ambo*, "both."

The ambo was ascended by steps; which occasioned that

that part of the office performed there to be called the *Gradual.* See GRADUAL.

Besides the gospel, which was read at the top of the ambo, and the epistle, which was read a step lower, they likewise published from this place the acts of the martyrs, the commemoration of departed saints, and the letters of peace and communion sent by one church to another: here, too, converts made a public profession of their faith; and bishops their defence, when accused: treaties also were sometimes concluded, and the coronations of emperors and kings performed, in the same place.

The modern reading-desks and pulpits have been generally substituted for the ancient ambos; though, in some churches, remains of the ambos are still seen. In that of St John de Lateran at Rome, there are two moveable ambos.

AMBOHITSMENE, or VOHITSANGHOMBE, a province of the island of Madagascar, so called from some red mountains of the same name, lying in S. Lat. 20°. These mountains are very high, resembling the Tafelberg of the Cape of Good Hope. On one side of this ridge the sea extends into the country for fifteen leagues; on the other is a flat country, abounding in ponds and marshes. Here is also a lake 15 leagues in length, and the same in breadth, containing many small islands. The inhabitants of the mountains are called *Zaferahongs;* and have plenty of gold, iron, cattle, silk, &c.

AMBOISE, a town of France, in the former province of Touraine, now the department of the Indre and Loire, seated at the confluence of the rivers Loire and Masse. The town is the capital of a district, and has been rendered famous in history by the conspiracy of the Protestants in 1560, which opened the fatal wars of religion in France. The castle is situated on a craggy rock, extremely difficult of access, and the sides of which are almost perpendicular. At its foot flows the Loire, which is divided into two streams by a small island. To this fortress the duke of Guise, when he expected an insurrection among the Huguenots, removed Francis II. as to a place of perfect security. Only two detached parts of the ancient castle now remain, one of which was constructed by Charles VIII. and the other by Francis I. The former of these princes was born and died at Amboise. The town is situated in E. Long. 1. 10. N. Lat. 47. 25.

AMBOISE, *D', Francis,* son of a surgeon to Charles IX. of France. He very early obtained the patronage of that prince, and was supported by his liberality in the prosecution of his studies at the university of Navarre, where he devoted his talents to rhetoric and philosophy with great assiduity and success. His eloquence and extensive information raised him in 1572 to the place of solicitor of the French nation. He afterwards applied to the study of the law, and became one of the most accomplished advocates of the parliament of Paris. He was next advanced to be counsellor in the parliament of Bretagne, and next to be a master of requests and counsellor of state. He visited different countries, and published the history of his travels, with several poetical pieces. He prefixed an apologetical preface to the edition of Abelard's works in 1616, and with much industry collected many of his manuscripts. His brother Adrian rose to considerable consequence in the church; and his brother James was not less eminent as a physician. *(Gen. Dict.)*

AMBOISE, *D', George,* a French cardinal and minister of state, was born in the year 1460. His father was a descendant of the renowned house of Amboise, and, through the influence of his powerful connexions, he beheld the path of church preferment open before his son; therefore he destined him to the clerical order. In these sanguine expectations he was not disappointed; for he had sufficient influence to procure for him the bishopric of Montauban at the early age of fourteen. Louis XI. appointed him one of his almoners; and in the course of political events, he became strongly attached to the duke of Orleans, and suffered imprisonment in his cause. When this prince, however, had regained his favour at court, he was elevated to the archbishopric of Narbonne. After he had remained there for some time, he changed that station for the archbishopric of Rouen. When the duke of Orleans was governor of Normandy, he made him lieutenant general; and in that situation he was of essential service to the province, in restoring justice and order. When the duke of Orleans became Louis XII. Amboise was suddenly raised to the elevated station of first minister and one of the cardinals. The same regard to equity, which characterized his conduct when lieutenant general induced him to diminish the imposts, which rendered him very popular as first minister of France. In 1499, by his advice, the king undertook the conquest of the Milanese, and, on their revolt, the first minister was sent to quell the rebellion. The great confidence which Louis had reposed in him, induced the pope to make him his legate in France; and, in that station, he piously laboured to reform the ecclesiastical orders. He enforced his doctrine by precept, not only in setting them an example of holding no more benefices than one at a time, but also by devoting two-thirds of the revenue of the same to the poor, and to the repair of religious edifices. According to his own account he was ambitious of the papal chair, "merely for the purpose of effecting the reformation of abuses and the correction of manners." It is reported that, upon the death of Pius III. he would have been elected pope had he not been deceived by the Italian cardinals. Disappointed in his views with regard to the papal honours, he persuaded his master to declare war against the Venetians, to whose influence he supposed his failure was owing. But this imprudent undertaking was suddenly interrupted; for in the prosecution of his journey for the Venetian war, he was seized with an illness, and confined in the city of Lyons. Affliction rouses the reflecting powers of the mind, and calls to remembrance the past actions of life. From the consciousness of his past errors and faults he was induced to express his contrition to a brother of the infirmary who attended him at the convent of the Celestines. In the year 1510, and in the 50th of his age, he breathed his last in that place. Industry, steadiness, and good intention, characterized his conduct as a prime minister. He shone with peculiar brightness as a man of literature. By his liberality and patronage, the arts and sciences flourished under his administration. It may be proper to add, that, assisted by some of

Amboule, Amboyna.

of the ableſt lawyers in the kingdom, he formed a code of laws to reform the reigning abuſes in the nation. Thus, by ſteadily purſuing the general welfare, he obtained the appellation of the "father of the people." *(Gen. Biog.)*

AMBOULE, a province of Madagaſcar, ſomewhat to the northward of S. Lat. 23°. It is a fertile and agreeable country, watered by the river Manampani, whoſe mouth lies in S. Lat. 23. 30. The country produces plants and fruits in plenty. Iron mines are alſo found here. The black cattle are extremely fat, and their fleſh excellent. In this province ſtands a large town of the ſame name; near which is a fountain of hot water, within 20 feet of a ſmall river whoſe ſand is almoſt burning. The water of the fountain is ſaid to boil an egg hard in two hours; and the inhabitants affirm it to be a ſovereign remedy againſt the gout. The people here are employed in different preparations of iron and ſteel, which they have from their own mines, and forge ſeveral inſtruments with tolerable ſkill. Their governor is honoured with the title of *Rabertau*, or *Great Lord*. He exerciſes ſovereign authority and abſolute power; but is frequently, in times of diſtreſs, ſurpriſed by his ſubjects, who aſſemble in great numbers, ſeize his perſon, and threaten him with death unleſs they are relieved. To extricate himſelf from this dilemma he is inſtantly obliged to iſſue orders for diſtributing proviſions among them; but is uſually repaid with intereſt, a quadruple return being made in a plentiful harveſt. The people of Amboule live in great licentiouſneſs with their ſuperiors, and their country is generally a retreat for the roguiſh and lazy.

AMBOYNA, one of the Molucca iſlands in the Eaſt Indies. It lies in S. Lat. 3. 36. and E. Long. 126. 20. and is remarkable for being the centre of the commerce for nutmegs and cloves, which is entirely monopolized by the Dutch Eaſt India Company. It is about 24 leagues in circumference. Beſides cloves, it likewiſe abounds in moſt of the tropical fruits and fiſh; nor is there here any deficiency of good water; but fleſh is very ſcarce. This ſcarcity, however, proceeds more from the policy of the Dutch than either the intemperature of the climate, or the barrenneſs of the ſoil: For, excepting cloves, they have in Amboyna, as well as the Moluccas, induſtriouſly diſcouraged the cultivation of every eſculent commodity, with the view of withholding ſubſiſtence from thoſe who might be tempted to invade them.

Of the natives, the men wear large whiſkers, but leave little hair upon the chin; and have only a ſlight piece of ſtuff wrapped round their middle. The women tie their hair in knots: the maids are bought of their fathers before they are married; and if the wife proves barren, the marriage is diſſolved. Some of the natives are Mahometans, and ſome Chriſtians: but they are all ſaid to be lazy, deceitful, and treacherous. They make war with ſmall ſwift veſſels, in ſhape like dragons with regard to the head and tail. Their houſes are built of bamboo canes and ſago trees. They ſleep on mats. Their weapons are bows and arrows, javelins, ſcimitars, and targets.

Amboyna was firſt diſcovered by the Portugueſe, who built a fort upon it, which was taken from them by the Dutch in 1605. They did not, however, become maſters of the whole iſland at once. The Engliſh had here five factors, who lived under the protection of the Dutch caſtle; holding themſelves ſafe, in reſpect of the friendſhip between the two nations. Great differences had ariſen between the Dutch and Engliſh coloniſts in this part of the world; till at laſt, the Engliſh Eaſt India Company applying to King James, a treaty was concluded in 1619, by which the concerns both of the Engliſh and Dutch were regulated, and certain meaſures agreed upon for preventing future diſputes. This was an additional ſecurity to the Engliſh; and, by virtue of the treaty, they continued two years in Amboyna, trading with the Dutch. During this time, however, ſeveral diſputes happened; which occaſioning mutual diſcontents, the complaints were ſent to Jacatra, in the iſland of Java Major, to the council of defence of both nations reſident there: but they not agreeing, a ſtate of the matter was ſent over to Europe, to be decided by the Eaſt India Companies of both nations; or, in caſe they could not agree, by the king of England and the ſtates of Holland, according to an article in the treaty of 1619.—But before theſe diſputes could be decided in a legal way, the Dutch, in order to give the more ſpecious colouring to the violent ſeizure which they meditated of the iſland of Amboyna, made uſe of the ſtale pretext of a conſpiracy being formed by the Engliſh and Japaneſe to diſpoſſeſs them of one of their forts in this place. The plot, it was alleged, had been confeſſed by a Japaneſe and Portugueſe in the Engliſh ſervice, who were moſt inhumanly tortured till they ſhould anſwer in the affirmative ſuch interrogatories as might favour the ſecret deſign of thoſe cruel inquiſitors. Upon the injurious evidence of this conſtrained declaration, they immediately accuſed the Engliſh factors of the pretended conſpiracy. Some of them they impriſoned, and others they loaded with irons, and ſent on board their ſhips; ſeizing at the ſame time all the Engliſh merchandiſe, with their writings and books.

Theſe acts of violence were followed by a ſcene of horror unexampled in the puniſhment of the moſt atrocious offenders. Some of the factors they tortured, by compelling them to ſwallow water till their bodies were diſtended to the utmoſt pitch; then taking the miſerable victims down from the boards to which they had been faſtened, and cauſing them to diſgorge the water: if they did not acknowledge the imputed guilt, the proceſs of torture was repeated. Others of the Engliſh they conſumed by burning them gradually from the feet upwards, in order to extort the confeſſion of a conſpiracy, which was only pretended by the infernal policy of thoſe ſavage tormentors. Some had the nails of the fingers and toes torn off; and in ſome they made holes in their breaſts, filling the cavities with inflammable materials, to which they afterwards put fire. Thoſe who did not expire under the agonies of torture were conſigned to the hands of the executioner.

The allegation of this pretended conſpiracy was equally void of probability and truth. The Dutch had a garriſon of 300 men in the fort, beſides the burghers in the town, and ſeveral other forts and garriſons in the iſland, while the number of the Engliſh did not amount to 20 men; nor were even thoſe provided with arms or ammunition to effect ſuch a deſign as that with which they were charged. There likewiſe was not one Engliſh

Amboyna. English vessel in the harbour, whereas the Dutch had eight ships riding near the town: neither, when the Dutch broke open the desks and trunks of the factors, was there found a single paper or letter which could be construed into the most distant relation to any conspiracy. Add to all this, that such of the unhappy sufferers as could speak to be heard, declared in the most solemn manner their innocence of the plot with which they were charged.

The whole of the transaction affords the most irrefragable testimony, that it was founded entirely upon a political fiction of the Hollanders, who had themselves formed the design of monopolizing the trade of the Spice Islands; for the accomplishment of which they perpetrated, about the same time, a singular tragedy at Pooleron, where they put to the torture 162 of the natives, whom they likewise charged with a pretended conspiracy. It may justly be reckoned singular in the fortune of this commercial republic, that they have ever since been permitted to enjoy in peace those invaluable islands, which were originally obtained by such atrocious infringements of humanity and the laws of nations, as will stain the Dutch annals, to the latest ages, with indelible infamy.

The more effectually to preserve this trade, the Dutch have had all the clove trees in the adjacent islands grubbed up. Sometimes also, when the harvest is very large, part of the produce of Amboyna itself is burnt. —To prevent the rearing of cloves in any of the neighbouring islands, or the inhabitants from selling them to strangers, the governor of Amboyna makes the tour of his government with a fleet of curricurries, consisting sometimes of 20, and at others of 30, 40, or 50 sail. This expedition is made with all the pomp imaginable, in order to gratify the pride and folly of the Indian chiefs. The true reason of their taking all this pains is, because experience has shown, that no contracts, however solemn, can prevent the inhabitants of those islands from selling their spice to strangers: and even now, frauds are so frequently practised by the Dutch themselves, though the Company is inexorable in punishing them, that the common people call the cloves *galken-kruid*, that is, the gallows spice.

Besides the cloves, coffee is also cultivated here by the Dutch, and a gold mine has been lately found out. This was discovered by the quantities of gold dust that were washed from some mountains by the torrents. Here also grow several kinds of valuable wood, of which they make tables, chairs, escrutoires, &c. for the principal persons in the government; and the rest is sold all over the Indies at a very extravagant rate.

Amboyna is divided into two parts, viz. a greater and lesser peninsula. The former, called *Hiton*, is 12 leagues in length, and two and a half broad. In this the Dutch have no less than five forts, or rather strong redoubts, mounted with cannon. The other is called *Leytimor*, five leagues in length, and one and a half broad, which is the southern part of the island; on this stands the fort of Victoria, which is the residence of the governor and his council, composed of 15 gentlemen or merchants. The fortress is a square, the ramparts mounted with 60 pieces of brass cannon, and the garrison usually composed of 600 men. It is so strong by nature and art, as to be in a manner impregnable; and so effectually does it command the harbour, that no vessel could come in or go out without being sunk by the cannon, if the governor chose. The inhabitants of Amboyna are computed at 70 or 80,000, of whom but a small number are Dutch: and this obliges the latter to be continually upon their guard, and to keep a competent number of troops in each of their forts, particularly in that of Middleburgh, which stands upon the isthmus that connects these peninsulas. There are also redoubts and garrisons in all the islands of this government.

Ambracia. AMBRACIA, one of the most considerable cities of ancient Epirus, situated on the river Aracthus, at a small distance from the sea. At first it was a free city; but was afterwards reduced by the Æacidæ kings of Epirus, who chose it for the place of their residence. In process of time, the Ætolians made themselves masters of it, and held it till the year before Christ 189, when it fell into the hands of the Romans.

At this time Ambracia was a place of great strength. It was defended on one side by the river Aracthus, and on the other by steep and craggy hills; and surrounded with a high and thick wall, above three miles in compass. The Roman consul Fulvius began the siege by forming two camps, separated by the river, but with a communication between them; the Romans were posted in one, and the Epirots their allies in the other. He then threw up two lines, one of circumvallation, the other of contravallation; and built a wooden tower in form of a castle, over against the citadel, which stood on a hill. The Ætolians, however, before the lines were quite finished, found means to throw about 1000 men into the place.

The lines being completed, the city was attacked in five different places at once. The battering rams shook the walls on all sides: and the Romans, from their moveable towers, pulled down the battlements with a kind of scythes, which they fastened to long beams. The besieged made a vigorous defence. They were night and day on the walls, and indefatigable in preventing the effects of the rams and scythes. The strokes of the former they deadened, by letting down beams, large stones, lumps of lead, &c. by means of pullies, upon them when they were in motion: the others they rendered useless, by pulling the beams to which they were fastened into the city with hooks contrived for the purpose.

While Fulvius was carrying on the siege, Nicander the Ætolian prætor, found means to throw 500 men into the city, under the command of one Nicodamus, with whom Nicander agreed to attack the Roman camp in the night time; not doubting, that, if the garrison from within, and the army from without, fell upon them at the same time, they would be obliged to raise the siege. Nicodamus narrowly watched the time at which he was ordered to sally; and though Nicander did not appear, marched out at the head of the garrison, armed with firebrands and torches. The Roman sentinels, surprised at this sight, ran to wake the legionaries, and soon spread a general alarm all over the camp. The legionaries marched in small bodies as they happened to meet, to repulse the enemy, whom they engaged in three different places. Two parties of the garrison were driven back; but the third, commanded by

Ambracia, Ambreada.

by two Ætolian generals, made a great ſlaughter of the Romans, and not finding themſelves ſeconded by Nicander, retired in good order into the city.

Though the beſieged were thus abandoned and had no hopes of aſſiſtance, they continued to defend themſelves with incredible vigour and reſolution. The Romans had no ſooner made a breach in the wall, but it was repaired, and a new one built behind it. The conſul, therefore, altered his meaſures; and, inſtead of making breaches with the ram, began to undermine the wall, in hopes of throwing down great part of it at once, and entering the city before the beſieged could have time to build a new wall. The miners being covered, were not obſerved by the garriſon, till the great quantities of earth brought out of the mine gave the alarm. The Ætolians immediately began to countermine; and having dug a trench of the depth they ſuppoſed the mine to be, they carried it along the wall where they heard the ſtrokes of the pickaxes of the Romans. When the two mines met, a battle enſued, firſt with pickaxes and ſpades, and then with ſwords and ſpears: but this attack did not laſt long, each party making themſelves a kind of rampart with the looſe earth. The Ætolians, in order to drive their enemies quite out of the mine, invented a machine which they brought to the place where the two mines met: this was a hollow veſſel with an iron bottom, bored through in many places, and armed with ſpikes at proper diſtances, to prevent the enemy from approaching it: this veſſel they filled with feathers, which they ſet on fire, and with bellows driving the ſmoke on the beſiegers, obliged them to leave the mine half ſuffocated. This interval the Ætolians made uſe of in repairing the foundations of the wall.

The vigorous reſiſtance made by the Ambracians, however, did not raiſe the courage of the nation in general, who were determined on a peace with Rome at all events. Fulvius, in the mean time, being deſirous of getting poſſeſſion of Ambracia before the concluſion of the peace, employed Amynander, king of the Athamanes, to perſuade the inhabitants to ſurrender. As Amynander had great intereſt in Ambracia, having long reſided there, he eaſily perſuaded them to capitulate on the following terms, viz. That the Ætolian garriſon ſhould have leave to march out of the city; that the inhabitants ſhould pay 500 talents, 200 down, and the reſt at ſix equal payments; and that they ſhould deliver to the conſul all the priſoners and deſerters that were in the city. The gates were then opened to Fulvius; and he was preſented with a crown of gold, together with many fine ſtatues and pictures, of which there were great numbers in the city, it having been the capital of Pyrrhus, who had enriched it with many valuable monuments.

From this time the city of Ambracia made no figure in hiſtory. It is ſcarcely known at preſent where the city ſtood; but that called *Arba*, in Upper Albania, ſeems beſt to agree with what is ſaid of the ancient ſituation of this city. The river Aracthus, on which Ambracia was ſituated, is now called by the natives *Spagmagmuriſi*.

AMBREADA, thus they call the falſe or fictitious amber, which the Europeans uſe in their trade with the negroes on the coaſt of Africa, and particularly on the river Senegal. There are ſome large and red pieces of it, a thouſand of which making twenty ropes or ſtrings, weigh three pounds. There are others ſmall, and alſo red, which weigh but two pounds and a half.

Ambreſbury ‖ Ambroſe.

AMBRESBURY, or Amesbury, a market town in Wiltſhire, about ſix miles north of Saliſbury, and ſituated in W. Long. 1. 40. and N. Lat. 51. 20.

AMBRONES, a Gauliſh people who lived near the foot of the Alps, between Switzerland and Provence. They invaded the Roman territories in conjunction with the Cimbri and Teutones; but were defeated with great ſlaughter by Marius, about 101 years before Chriſt. Their women, who had ſtaid during the engagement in a kind of fortification made with their carts, on ſeeing their huſbands flying, and the Romans at their heels, armed themſelves with axes, and, gnaſhing with their teeth, fell with fury on the purſuers and the purſued. Their firſt rage being ſpent, they deſired to ſurrender themſelves, upon the ſingle condition, that their chaſtity ſhould not be violated; but this equitable requeſt being denied, they firſt killed their children, and then themſelves, not one remaining alive out of the whole multitude.

AMBROSE, Saint, an iſland in the South Pacific ocean, on the coaſt of Chili, four or five leagues due weſt from St Felix iſland. At firſt view, it appears like two ſmall iſlands; but after a nearer approach, it is found they are joined by a reef. It lies in S. Lat. 26. 13. W. Long. 80. 55. from Greenwich. There is a large rock 4 miles to the northward of the iſland, called, from its appearance, *Sail-rock*. Captain Roberts, who was here in 1792, found St Felix iſland inacceſſible. On St Ambroſe iſland, his crew killed and cured 13,000 ſeal ſkins of the beſt quality, in ſeven weeks. The iſland has little elſe to recommend it. Fiſh and crawfiſh abound. The beſt ſeaſon for ſealing is from the 1ſt of April to the 1ſt of Auguſt.

Ambrose of Alexandria, lived in the beginning of the third century, and was the intimate friend of Origen. Jerome and Euſebius differ in the account they give of this man. The one denominates him a Marcionite, the other a Valentinian; but they both agree that he was converted to the orthodox faith, through means of the preaching of Origen. As is generally the caſe with new proſelytes, he became very zealous, and was appointed deacon either at Alexandria, or at Cæſarea, where Protectetus was preſbyter. Origen dedicated many of his works, and among others his book on martyrdom, to Ambroſe; at whoſe deſire and expence they were publiſhed. Origen and Ambroſe were alike indefatigable in their application to ſtudy, and lived in terms of the moſt intimate friendſhip. Origen being poor, Ambroſe aſſiſted him, by providing notaries and amanuenſes to copy his works.

In that period of ſociety, when the increaſe of copies was a work of immenſe labour and great expence, theſe were not only inſtances of private friendſhip, but of public utility. Ambroſe is thus juſtly entitled to rank among the patrons of learning. Ambroſe has been blamed by ſome, for having made no proviſion at his death for the poor infirm Origen. The friends of Ambroſe excuſe this part of his conduct, by ſaying, that Origen choſe to live poor, and daily dependant on

Ambrose. a divine Providence. According to some historians, Ambrose died as a martyr, along with his friend Protectetus, in the persecution under Maximin, about the year 236; but the dedication of Origen's eight books against Celsus shews, that though he died before Origen, yet he lived to the year 250, or near that period. Origen speaks of him as a man of great piety, and much devoted to the study of the sacred Scriptures. (*Gen. Biog.*)

Ambrose, bishop of Milan, was one of the most eminent fathers of the church in the fourth century. He was a citizen of Rome, and born in France; some historians say in the year 334, but others say in the year 340. The birth of Ambrose is said to have been attended with a remarkable presage of his future eloquence, by a swarm of bees coming and settling upon his mouth as he lay in his cradle. At the period of his birth, his father was Prætorian prefect of Gallia Narbonensis; but upon his death, the widow repaired to Rome with her family. Ambrose received a religious education, and was reared in the habits of virtuous conduct by his mother, who was an accomplished woman, and eminent for piety. The names of those masters who instructed him in the rudiments of the Greek and Roman literature have not been transmitted to posterity: but in these branches he made early proficiency; and, having directed his attention to the law, he employed his eloquence with such reputation in the Prætorian court of Anicius Probus, that he was soon deemed worthy of a place in the council. After he had continued in this station for some time, Probus appointed him consular of Liguria and Emilia, comprehending the territories of Milan, Liguria, Turin, Genoa, and Bologna. Milan was chosen for the place of his residence, and by the prudent and gentle use of his power, he conducted the affairs of the province with general approbation and growing popularity.

In the year 374, Auxentius the bishop of that city died, and his death gave a sudden change to the fortune and literary pursuits of Ambrose. At that period, the tide of religious contention ran high between the Catholics and the Arians, and there ensued a strong contest concerning the choice of a new bishop. When the people were assembled in the church to elect, Ambrose, in the character of governor of the place, went into the assembly, and, in a grave, eloquent, and pathetic address, admonished the multitude to lay aside their contentions, and, in the spirit of religious meekness, to proceed to the important work of choosing a bishop. It is reported, that when Ambrose had finished his address, a child cried out, "Ambrose is bishop." The agitated multitude suddenly caught the superstitious flame, and regarding this as a miraculous intimation, they unanimously elected Ambrose bishop of Milan. Some suppose that this was entirely a device of Ambrose or his friends, and others ascribe it to mere accident. Ambrose strongly affected reluctance, and even pretended to fly from the city in order to avoid the intended honour. It is, however, unfortunate for the artifice of the governor that the place of his concealment was soon discovered, when the will of the emperor was known concerning the confirmation of his election. Finding it inconvenient any longer to resist the public choice, he exchanged the ensigns of civil for those of ecclesiastical dignity; and, after being baptized, he was ordained bishop of Milan, about the end of the year 374. Ambrose.

But whatever may be the sentiments of mankind concerning the singular conduct of Ambrose in accepting an office for which he was certainly unqualified in respect of previous studies, habits, and employments, yet it must be admitted, that he immediately betook himself to the necessary studies, and with ability, boldness, and integrity, acquitted himself in his new elevation. Having appropriated his money to the poor, settled his lands upon the church, with the exception of making his sister tenant during life, and having committed the care of his family to his brother, he entered upon a regular course of theological study, under the care of Simplician, a presbyter of Rome, and devoted himself to the labours of the church.

Compelled by the irruption of the Goths and the northern barbarians, who rushed down upon the Roman empire, spreading terror and desolation all around, Ambrose, along with several others, fled to Illyricum; but he remained only a short period in exile, for the northern invaders were quickly defeated by the forces of the emperor, and driven back with considerable loss into their own dominions; therefore, he and his companions returned to their respective habitations.

After he returned to his ecclesiastic station, the eloquence and abilities of that zealous bishop found ample scope in the dispute between the Arians and the Catholics. About this era, the doctrine of Arius concerning the person of Christ had been extensively received, and had many powerful defenders, both among the clergy and the common people. Ambrose espoused the cause of the Catholics. Gratian, the son of the elder Valentinian, marshalled on the same side. But the younger Valentinian, who was now become his colleague in the empire, adopted the opinions of the Arians; and all the arguments and eloquence of Ambrose were insufficient to reclaim the young prince to the orthodox faith. Theodosius, the emperor of the east, also professed the orthodox faith, yet there were numerous adherents to Arius scattered throughout his dominions. In this general state of religious opinions in the empire, two leaders of the Arians, Palladius and Secundianus, confident of numbers, prevailed upon Gratian to call a general council from all parts of the empire. This request appeared so equitable that he complied without hesitation, but Ambrose, aware of the consequence, had the eloquence to persuade the emperor that a general council was improper, and that the matter could be determined by a council of the western bishops. The result was, that a synod, composed of 32 bishops, was held at Aquileia in the year 381. Ambrose was elected president, and Palladius being called upon to defend his opinions, declined; insisting that the meeting was a partial one, and that the whole bishops of the empire not being present, the sense of the Christian church could not be obtained concerning the question in dispute. Ambrose mentioned several precedents in favour of the authority of the court, and added, that the oriental bishops being acquainted with the place and nature of the meeting, might have been present, if they had deemed the matter in discussion

Ambrose. ſion worthy of their attention; therefore, the court, although Palladius perſiſted in his refuſal to plead his cauſe, put the vote, and he, along with his aſſociate Secundianus, was ejected from the epiſcopal office. If Ambroſe diſplayed great zeal in oppoſing the errors of Arius, he diſplayed equal zeal in oppoſing the heathen ſuperſtitions. Many of the ſenators remaining ſtrongly attached to the heathen idolatry, upon Valentinian II. aſcending the throne, they made a vigorous effort to reſtore the worſhip of the heathen deities. Symmachus, a very opulent man, and a great orator, who was at that time prefect of the city, was entruſted with the management of the Pagan cauſe, and drew up a petition, praying that the altar of Victory might be reſtored to its ancient ſtation in the hall of the ſenate, and for the proper ſupport of ſeven veſtal virgins, and the regular obſervance of the other Pagan ceremonies. Great eloquence and peculiar inſinuation characterized the petition. He argued that this form of religion had long been profitable to the Roman ſtate, reminded the emperor how much Rome had been indebted to victory, and that it had been the uniform cuſtom of the ſenators to ſwear fidelity to the government upon that altar. He likewiſe produced many facts to prove the advantages derived to the ſtate from its ancient religious inſtitutions, and inſinuated that it was one divinity that all men worſhipped under different forms, ſo that ancient practice ſhould not be raſhly laid aſide. He even proceeded ſo far as to ſtate the injuſtice of increaſing the public revenue by robbing the church, and attributed the late famine which had overtaken the empire to the neglect of the ancient worſhip.

To this petition, Ambroſe replied in a letter to Valentinian, arguing that the devoted worſhippers of idols had often been forſaken by their deities; that the native valour of the Roman ſoldiers had gained her victories, and not the pretended influence of Pagan prieſts; that theſe idolatrous worſhippers requeſted for themſelves what they refuſed to Chriſtians; that willing virginity was more honourable than that procured by the public money; that as the Chriſtian miniſters declined taking temporal emoluments, they ſhould alſo be denied to Pagan prieſts; that it was abſurd to ſuppoſe that God would ſend a famine upon the empire for neglecting to ſupport a religious ſyſtem contrary to his revealed will in the Scriptures; that the whole proceſs of nature encouraged innovations; and that all nations had permitted theſe, even in religion; that heathen ſacrifices were exceedingly offenſive to Chriſtians; and that every Chriſtian prince ſhould ſuppreſs theſe Pagan ceremonies.

In the epiſtles of Symmachus and of Ambroſe, both the petition and the reply are preſerved, in which ſophiſtry, ſuperſtition, ſound ſenſe, and ſolid argument, are ſtrangely blended. It is ſcarcely neceſſary to add that the petition was unſucceſsful.

The increaſing ſtrength of the Arians proved too formidable for the zealous Ambroſe. The young emperor and Juſtina, along with a conſiderable number of clergy and laity profeſſing the Arian faith, requeſted from the biſhop the uſe of two churches, one in the city, the other in the ſuburbs of Milan. The prelate believing the biſhops to be the guardians, both of the temporal and ſpiritual intereſts of the church, and that the religious edifices were the unqueſtionable property of the church, poſitively refuſed to deliver up the temples of the Lord into the impious hands of heretics. Filled with indignation, Juſtina reſolved to employ the imperial authority of her ſon in procuring by force what ſhe could not by perſuaſion. Ambroſe was required to anſwer for his conduct before the council. He went, attended by a numerous crowd of people, whoſe impetuous zeal ſo overawed the miniſters of Valentinian, that he was permitted to retire without making the ſurrender of the churches. The day following, when he was performing divine ſervice in the Baſilica, the prefect of the city came to perſuade him to give up at leaſt the Portian church in the ſuburbs. Still continuing obſtinate, the court proceeded to violent meaſures. The officers of the houſehold were commanded to prepare the Baſilica and the Portian churches to celebrate divine ſervice upon the arrival of the emperor and his mother at the enſuing feſtival of Eaſter. The order reſpecting one of them was carried into effect, but the court perceiving the growing ſtrength of the prelate's intereſt, deemed it prudent to uſe ſofter meaſures; but all meaſures proved in vain: the biſhop boldly replied, "If you demand my perſon, I am ready to ſubmit: carry me to priſon or to death, I will not reſiſt; but I will never betray the church of Chriſt. I will not call upon the people to ſuccour me; I will die at the foot of the altar, rather than deſert it. The tumult of the people I will not encourage, but God alone can appeaſe." This ſtrong declaration was followed by a torrent of eloquence from the pulpit, purſuing his ſcheme with the moſt violent zeal. But the court remained unconvinced, and another attempt being made, under a ſtrong guard of ferocious Goths, to ſeize the church of Baſilica; when they were about to enter, Ambroſe thundered the ſentence of excommunication againſt them, and ſo overawed them that they retired; and Ambroſe and his friends remained in poſſeſſion of the churches. About this time, alſo, an Arian biſhop challenged Ambroſe to a diſpute before the emperor; but he declined, ſaying that matters of faith ſhould be determined by a council of biſhops.

Many circumſtances in the hiſtory of Ambroſe are ſtrongly characteriſtic of the general ſpirit of the times. The chief cauſes of his victory over his opponents were, his great popularity, and the ſuperſtitious reverence paid to the epiſcopal character at that period of ſociety. But it muſt alſo be admitted, that he uſed ſeveral indirect means to obtain and ſupport his popular authority. Many indigent perſons were ſupported by his liberal bounty; in his explanations of Scripture he made conſtant and ſevere alluſions to exiſting and public characters; the alternate mode of ſinging had no ſmall effect upon the minds of the vulgar. At a time when the influence of Ambroſe required vigorous ſupport, he fortunately was admoniſhed in a dream to ſearch for the remains of Gervaſius and Protaſius, two martyrs who had quietly repoſed under the pavement of the church. The ſkeletons were found entire, were ſtained with blood, and the head of one of them ſeparated from the body. The vulgar crowded in thouſands to behold theſe venerable relics. According to report, Ambrose. report, a blind man was restored to sight, several demons were expelled, and sick persons healed by touching these bones. Ambrose exulted in these miracles, and appealed to them in his eloquent sermons; whilst the court derided and called in question their existence. The bishop continued firm in his opinions; the people believed; and the existence of the miracles was established. And it is a very singular fact, that these, and many other miracles, obtained current credit among the Christian historians of the second, third, and fourth centuries. Dr Cave in speaking of them says, "I make no doubt but God suffered them to be wrought, at this time, on purpose to confront the Arian impieties."

Although the court were displeased with the religious principles and conduct of Ambrose, yet they respected his great political talents; and when necessity required, they solicited his aid, which he generously granted. When Maxentius usurped the supreme power in Gaul, and was meditating a descent upon Italy, Valentinian sent Ambrose to him, who prevailed upon him to desist from the undertaking. On a second attempt of the same kind Ambrose was employed; and, although he was unsuccessful, yet, if his advice had been followed upon his return, the schemes of the usurper would have proved abortive; but indifferent to his counsels, the enemy was permitted to enter Italy, and Milan was taken. Justina and her son fled; but Ambrose remained in his station, and proved beneficial to many of the sufferers, by causing the plate of the church to be melted for their relief. Theodosius, the emperor of the East, espoused the cause of Justina, and by force of arms regained the kingdom.

In the year 390, a tumult happened at Thessalonica, in which Botheric, one of the officers of Theodosius was slain; and he was so greatly enraged, that he issued a royal mandate for the promiscuous massacre of the inhabitants of that place: and about seven thousand persons were assassinated, without distinction or mercy. The courageous Ambrose, informed of this deed, wrote to the emperor a severe reproof, and an earnest admonition, charging him not to approach the holy communion with his hands stained with innocent blood. When the emperor was about to enter the church of Milan to attend upon the service, the bishop met him, and with a stern countenance prohibited him from approaching the temple of God. The emperor reminded him that David had been guilty of murder and of adultery. The bishop replied, You have "imitated David in his guilt; go and imitate him in his repentance." The prince obeyed the priest, and, by a course of penitential sorrow, during the space of eight months, he laboured to regain the favour of the church. After the termination of this period, he was absolved, but at the same time was made to sign an edict that an interval of thirty days should intervene before the sentence of death or confiscation should be put in execution. When the mind reflects upon the numerous bad effects of instant and violent passion, this measure was certainly fraught with policy and humanity. If the reader laments the weakness which subjected the conscience to the clerical power, he must be gratified that a moderate use was made of that authority.

The undaunted courage of Ambrose received another severe trial in the year 393, after the assassination of Valentinian, and the base Eugenio had usurped the empire of the west. Rather than join the standard of the usurper, he fled from Milan. But after the army of Theodosius was victorious, he generously supplicated the emperor for the pardon of those who had supported the cause of Eugenio. Theodosius, soon after he had acquired the uncontrolled possession of the Roman empire, died at Milan. The bishop did not long survive the emperor; but died in the year 397. In his last illness he preserved perfect composure of mind, informing his friends that he had endeavoured so to conduct himself that he might neither be ashamed to live nor to die.

On many accounts the character of the bishop of Milan stands high among the fathers of the ancient church. With unvarying steadiness he delivered his religious sentiments on all occasions; with unwearied assiduity he discharged the duties of his office; with unabated zeal and boldness he defended the orthodox cause, in opposition to the Arians; with a liberal hand he fed the numerous poor who flocked to his dwelling; with uncommon generosity he manifested kindness to his adversaries; and with Christian affection he sought the happiness of all men. His general habits were amiable and virtuous, and his powers of mind were uncommonly vigorous and persevering. Ambition and bigotry were the chief blemishes in his character.

The writings of Ambrose are voluminous, although little more than adulterated editions of Origen and other Greek fathers. The great design of his writings was to defend and propagate the Catholic faith. In some of these he recommends perpetual celibacy as the perfection of Christian virtue. Modern judgment and taste may perhaps induce some to esteem the writings of Ambrose absurd, trivial, and even ludicrous; but there is a smartness and vigour in his style, and there are excellent sentiments interspersed, which render the writings of the bishop of Milan worthy of a perusal. With his usual severity and acrimony, Gibbons too severely censures this prelate. "Ambrose (says he) could act better than he could write; his compositions are destitute of taste or genius, without the spirit of Tertullian, the copious elegance of Lactantius, the lively wit of Jerome, or the grave energy of Augustin." The most accurate and complete edition of his works, is that published by the Benedictine monks printed at Paris in two volumes in 1682. (*Gen. Biog*).

Ambrose, *Isaac*, an eminent Presbyterian minister, was educated at Brazen-nose college Oxford, where he took the degree of bachelor of arts, and became minister of Preston, and afterwards of Garstang in Lancashire, whence he was in 1662 ejected for nonconformity. It was usual for him to retire every year for a month into a little hut in a wood, where he shunned all society, and devoted himself to religious contemplation. Dr Calamy observes, that he had a very strong impulse on his mind of the approach of death, and took a formal leave of his friends at their houses a little before his departure; and the last night of his life he sent his discourse concerning *angels* to the press. The next day he shut himself up in his parlour, where to the great surprise and regret of all who saw him, he was

was found just expiring. He died in 1663-4, in the 72d year of his age. He wrote several other books; as the *Prima, Media, et Ultima*, or the First, Middle, and Last Things; War with Devils; Looking unto Jesus, &c.

Ambrose, or *St Ambrose in the Wood*, an order of religious, who use the Ambrosian office, and wear an image of that saint engraven on a little plate: in other respects they conform to the rule of the Augustins. See *Ambrosian Office* and Augustins.

AMBROSIA, in *Heathen Antiquity*, denotes the solid food of the gods, in contradistinction from their drink, which was called *nectar*. It had the appellation *ambrosia* (compounded of the particle α privative, and βροτος *mortal*), as being supposed to render those immortal who fed on it.

Ambrosia is also a splendid kind of title, given by some physicians to certain alexipharmic compositions of extraordinary virtue. The name was particularly given to a famous antidote of Philip of Macedon against all poisons, bites, and stings of venomous creatures, as well as many internal diseases.

Ambrosia. See Botany *Index*.

AMBROSIAN office or rite, in *Church History*, a particular formula of worship in the church of Milan, which takes its name from St Ambrose, who instituted that office in the fourth century. Each church originally had its particular office; and when the Pope, in after times, took upon him to impose the Roman office upon all the western churches, that of Milan sheltered itself under the name and authority of St Ambrose; from which time the Ambrosian ritual has prevailed.

AMBROSIN, in middle-age writers, denotes a coin struck by the lords or dukes of Milan, whereon was represented St Ambrose on horseback, with a whip in his right hand. The occasion of this coinage is said to have been a vision of that saint, who appeared to the Milanese general in 1339, during the time of a battle.

AMBROSINIA. See Botany *Index*.

AMBROSIUS Aurelianus, or Aurelius Ambrosius, a famous general of the ancient Britons, of Roman extraction. He was educated at the court of Aldroen of Armorica: who, at the request of the Britons, sent him over with 10,000 men, to assist them against the Saxons, whom Vortigern had invited into Britain. Ambrosius had such success against the Saxons, that the Britons chose him for their king, and compelled Vortigern to give up to him all the western part of the kingdom divided by the Roman highway called *Watling-street*. Some time after, the Britons being discontented with Vortigern, and having withdrawn their allegiance from him, he retired to a castle in Wales, where being besieged by Ambrosius, and the castle taking fire, he perished in the flames, and left his rival sole monarch of Britain; who now took upon him the imperial purple, after the manner of the Roman emperors. Geoffrey of Monmouth tells us, that Ambrosius built Stonehenge near Salisbury in Wiltshire. Ambrosius, according to this historian, coming to a monastery near Caercaradoc, now Salisbury, where three hundred British lords, massacred by Hengist, lay buried, and resolving to perpetuate the memory of this action, he ordered his workmen to prepare a large quantity of stones and other materials. But having, at the instigation of Tremounus archbishop of Caerleon, consulted the famous Merlin, this magician advised him to send over to Ireland for certain great stones, called *chorea gigantum*, the giant's dance, placed in a circle on a hill called *Killair*, which were brought thither by giants from the farthest borders of Africa. A body of forces was accordingly sent into Ireland, under Pendragon, Ambrosius's brother, to fetch these stones; but were opposed in their attempt by Gillomanus king of the country, who derided the folly of the Britons in undertaking so ridiculous an expedition. Nevertheless, the Britons having vanquished this prince in battle, brought away the stones; and by the direction and assistance of Merlin, who had accompanied them, these wonderful stones, by order of Ambrosius, were placed over the graves of the British lords, and are now what is called *Stonehenge*. Alexander Mecham celebrates this fable in his poem *De divinæ sapientiæ laudibus*. Polydore Virgil assigns another origin of Stonehenge: he tells us it was erected by the Britons as a monument to their general Ambrosius, on the place where he fell in battle, to perpetuate the memory of his glorious actions and services done to his country. Both these stories are rejected by our best antiquaries; who, however, are by no means agreed as to the true origin of this famous piece of antiquity. See Stonehenge.

After the Britons had defeated the Saxons, and obliged them to retire northward, Ambrosius is said to have convened the princes and great men at York, where he gave orders for repairing the churches destroyed by the Saxons, and restoring the exercise of religion to its former lustre. This is confirmed by Matthew of Westminster; who highly applauds the great zeal of Ambrosius in repairing the churches, encouraging the clergy, and restoring the honour of religion. The Monmouth historian gives this prince a very high character. "He was a man (says he) of such bravery and courage, that when he was in Gaul no one durst enter the lists with him; for he was sure to unhorse his antagonist, or to break his spear into shivers. He was, moreover, generous in bestowing, careful in performing religious duties, moderate in all things, and more especially abhorred a lie. He was strong on foot, stronger on horseback, and perfectly qualified to command an army." The same author tells us he was poisoned at Winchester by one Eopa a Saxon, disguised as a physician, and hired for that purpose by Pascentius one of the sons of Vortigern: but the generally received opinion is, that he was killed in a battle which he lost in the year 508, against Cerdic, one of the Saxon generals.

AMBRY, a place in which are deposited all utensils necessary for house-keeping. In the ancient abbeys and priories, there was an office under this denomination, wherein were laid up all charities for the poor.

AMBUBAJÆ, in *Roman Antiquity*, were immodest women, who came from Syria to Rome, where they lived by prostitution, and by playing on the flute: the word is derived from the Syriac *abub*, which signifies a flute; although others make it to come from *am* and *Baiæ*, because these prostitutes often retired to Baiæ. According

According to Cruquius, these women used likewise to sell paint for ornamenting the face, &c.

AMBULANT, or AMBULATORY. They gave in France the name of *Ambulant commissioners* to those commissioners, or clerks of the king's farms, who had no settled office; but visited all the offices within a certain district, to see that nothing was done in them against the king's right and the interest of the farm.

AMBULANT is also used to denote those brokers at Amsterdam, or exchange agents, who have not been sworn before the magistrates. They transact brokerage business, but their testimony is not received in the courts of justice.

AMBULATORY, a term anciently applied to such courts, &c. as were not fixed to any certain place; but held sometimes in one place, and sometimes in another: in opposition to stationary courts.—The court of parliament was anciently ambulatory; so also were the courts of king's bench, &c.

AMBURBIUM, in *Roman Antiquity*, a procession made by the Romans round the city and pomœrium, in which they led a victim, and afterwards sacrificed it, in order to avert some calamity that threatened the city.

AMBURY, or ANBURY, among *Farriers*, denotes a tumour, wart, or swelling, which is soft to the touch, and full of blood.

This disorder of horses is cured by tying a horse-hair very hard about its root: and, when it has fallen off, which commonly happens in about eight days, strewing some powder of verdigris upon the part, to prevent the return of the complaint. If the tumour be so low that nothing can be tied about it, they cut it out with a knife, or else burn it off with a sharp hot iron; and, in finewy parts, where a hot iron is improper, they eat it away with oil of vitriol, or white sublimate.

Many of our farriers boast of a secret which infallibly cures all protuberances of this kind; the preparation of which is this: Take three ounces of green vitriol and one ounce of white arsenic; beat them to a coarse powder, and put them into a crucible; place the crucible in the midst of a charcoal fire, stirring the substance, but carefully avoiding the poisonous steams: when the whole grows reddish, take the crucible out of the fire, and when cool, break it and take out the matter at the bottom; beat this to powder in a mortar, and add to four ounces of this powder five ounces of *album rhosis;* make the whole into an ointment, and let it be applied cold to warts; rubbing them with it every day. They will by this means fall off gently and easily, without leaving any swellings. It is best to keep the horse quiet, and without working, during the cure. What sores remain on the parts from which the swellings fall off, may be cured with the common application called the *countess's ointment*.

AMBUSCADE, or AMBUSH, in the *Military Art*, properly denotes a place where soldiers may lie concealed till they find an opportunity to surprise the enemy.

In the language of Scripture, these terms are not always taken in their proper signification, for laying ambushes for any one, attacking him in secret, laying snares for him. They sometimes signify no more than attacking a man who has no distrust of such a thing; attacking one behind, concealing one's self in some particular place in order to surprise any one. See the book of Judges, ch. ix. 25, 32, 34, 35. Abimelech, who lay lurking with his people in the heights of Sichem, so, however, as to rob and treat those who passed that way very ill, came and attacked the city of Sichem with his troops divided into three bodies: *Tetendit insidias juxta Sichimam in quatuor locis*. Literally, according to the Hebrew, "They prepared ambuscades against Sichem in four heads or companies." And a little farther, verse 43. "Abimelech, being informed that the Sichemites had marched, took his army and divided it into three bodies, and laid wait for them in the field." It seems certain, that in these passages ambushes, properly so called, were not the things in question. In the first book of Samuel, Saul complains that David laid ambuscades for him: *Insidiator usque hodie permanens*. Now nothing could be worse grounded than this accusation, if we understand the word *insidiari* in its proper signification; but he might say, though unjustly, that David was his secret enemy. And in the Chronicles it is said, that God turned the ambushes laid by the enemies of Israel upon themselves; that is to say, their endeavours, their malice, their arms, he turned against themselves; for the enemies there mentioned came not in private or by stratagem; they marched openly in arms against Israel.

AMBY, a town of the Austrian Netherlands, in the province of Limburg, situated opposite to Maestricht, on the east side of the river Maese, in E. Long. 5. 45. N. Lat. 50. 57.

AMEDIANS, in *Church History*, a congregation of religious in Italy, so called from their professing themselves *amantes Deum*, "lovers of God;" or rather *amati Deo*, "beloved of God." They wore a gray habit and wooden shoes, had no breeches, and girt themselves with a cord. They had 28 convents; and were united by Pope Pius V. partly with the Cistercian order, and partly with that of the Soccolanti, or wooden shoe wearers.

AMELIA, an episcopal city of Italy, in the state of the church, seated on a mountain, in the duchy of Spoletto. E. Long. 13. 20. N. Lat. 42. 33.

AMELIA, a county in Virginia, situated between the Blue-ridge and the tide waters, having Cumberland county on the north, Prince George county on the east, and Lunenburg county on the south and west. Amelia, including Nottaway, a new county, contains 18,097 inhabitants, of whom 11,037 are slaves.

AMELIA *Isle*, on the coast of East Florida, lies about seven leagues north of St Augustine, and very near Talbot island on the south, at the mouth of St John's river. Is is 13 miles long and 2 broad, is very fertile, and has an excellent harbour. Its north end lies opposite Cumberland island, between which and Amelia isle is the entry into St Mary's river, in N. Lat. 30. 52. W. Long. 67. 23.

AMELLUS, STARWORT. See BOTANY *Index*.

AMELOT DE LA HOUSSAI, *Nicholas*, born at Orleans in 1634, was much esteemed at the court of France, and

and appointed ſecretary of an embaſſy which that court ſent to the commonwealth of Venice, as appears by the title of his Tranſlation of Father Paul's Hiſtory of the Council of Trent; but he afterwards publiſhed writings which gave ſuch offence, that he was impriſoned in the Baſtile. The firſt works he printed were the Hiſtory of the Government of Venice, and that of the Uſcoks, a people of Croatia. In 1683 he publiſhed his tranſlations into French of Machiavel's Prince, and Father Paul's Hiſtory of the Council of Trent, and Political Diſcourſes of his own upon Tacitus. Theſe performances were well received by the public. He did not prefix his own name to the two laſt-mentioned works, but concealed himſelf under that of La Mothe Joſſeval. His tranſlation of Father Paul was attacked by the partiſans of the pope's unbounded power and authority. In France, however, it met with great ſucceſs; all the advocates for the liberty of the Gallican church promoting the ſucceſs of it to the utmoſt of their power, though at the ſame time there were three memorials preſented to have it ſuppreſſed. When the ſecond edition of this tranſlation was publiſhed, it was violently attacked by the Abbé St Real, in a letter he wrote to Mr Bayle, dated October 17. 1685. Amelot defended himſelf in a letter to the ſame gentleman. In 1684, he printed, at Paris, a French tranſlation of Baltaſar Gracian's *Oracula Manual*, with the title of *l'Homme de Cour*. In 1686, he printed *La Morale de Tacite de la Flatterie;* in which work he collected ſeveral particular facts and maxims, which repreſent in a ſtrong light the artifices of court flatterers, and the miſchievous effect of their poiſonous diſcourſes. Frederick Leonard, a bookſeller at Paris, having propoſed, in the year 1692, to print a collection of all the treaties of peace between the kings of France and all the other princes of Europe, ſince the reign of Charles VII. to the year 1690, Amelot publiſhed a ſmall volume in duodecimo, containing a preliminary diſcourſe upon theſe treaties; wherein he endeavours to ſhow, that moſt princes, when they enter into a treaty, think more how to evade than how to perform the terms they ſubſcribe to. He publiſhed alſo an edition of Cardinal d'Oſſat's letters in 1697, with ſeveral obſervations of his own; which, as he tells us in his advertiſement, may ſerve as a ſupplement to the hiſtory of the reigns of Henry III. and Henry IV. kings of France. He wrote ſeveral other works; and died at Paris in 1706, at the age of 73. Amelot was at one time confined in the Baſtile, probably on account of his political writings.

AMELOTTE Denis, a celebrated French writer, was born at Saintonge in 1606. He maintained a cloſe correſpondence with the fathers of the Oratory, a congregation of prieſts founded by Philip of Neri. He wrote the life of Charles de Gendron, ſecond ſuperior of this congregation, and publiſhed it at Paris in 1643. In this work he ſaid ſomething of the famous Abbot of St Cyran, which greatly diſpleaſed the gentlemen of Port Royal, who, out of revenge, publiſhed a libel againſt him, entitled *Idéé génerale de l'eſprit et de livre de P. Amelotte.* He was ſo much provoked by this ſatire, that he did all in his power to injure them. They had finiſhed a tranſlation of the New Teſtament, and were deſirous to have it publiſhed; for which purpoſe they endeavoured to procure an approbation from the doctors of the Sorbonne, and a privilege from the king. But Amelotte, by his influence with the chancellor, prevented them from ſucceeding. In this he had alſo a view to his own intereſt; for he was about to publiſh a tranſlation of his own. Amelotte's tranſlation with annotations, in 4 volumes octavo, was printed in the years 1666, 1667, and 1668. It is not very accurate, according to F. Simon, who tells us that it contains ſome very groſs blunders. Amelotte wrote alſo an Abridgement of Divinity, a Catechiſm for the Jubilee, and a kind of Chriſtian Manual for every day. Towards the end of his life, he entered into the congregation of the Oratory in 1650; and continued amongſt them till his death, which happened in 1678.

AMEN, אמן, ſignifies *true*, *faithful*, *certain*. It is made uſe of likewiſe to affirm any thing, and was a ſort of affirmation uſed often by our Saviour: Αμην, Αμην, λεγω υμιν, i. e. *Verily, verily, I ſay unto you.* Laſtly, It is underſtood as expreſſing a wiſh: as *Amen, So be it*, (Numb. v. 22.) or an affirmation, *Amen, yes I believe it*, 1 Cor. xiv. 16. The Hebrews end the five books of Pſalms, according to their way of diſtributing them, with the words *Amen, amen;* which the Septuagint have tranſlated γενοιτο, γενοιτο; and the Latins, *Fiat, fiat.* The Greek and Latin churches have preſerved this word in their prayers, as well as *alleluiah* and *hoſannah;* becauſe they obſerved more energy in them than in any terms which they could uſe in their own languages. At the concluſion of the public prayers, the people anſwered with a loud voice, Amen; and St Jerome ſays, that at Rome, when the people anſwered Amen, the ſound of their voices was like a clap of thunder: *In ſimilitudinem cæleſtis tonitrui Amen reboat.* The Jews aſſert, that the gates of heaven are opened to him who anſwers *Amen* with all his might.

AMEND, or Amende, in the *French Cuſtoms*, a pecuniary puniſhment impoſed by a judge for any crime, falſe proſecution, or groundleſs appeal.

Amende Honorable, a ſpecies of puniſhment formerly inflicted in France upon traitors, parricides, or ſacrilegious perſons, in the following manner: The offender being delivered into the hands of the hangman, his ſhirt is ſtripped off, a rope put about his neck, and a taper in his hand; then he is led into court, where he muſt beg pardon of God, the king, the court, and his country. Sometimes the puniſhment ends here; but ſometimes it is only a prelude to death, or baniſhment to the galleys.

Amende Honorable, is a term alſo uſed for making recantation in open court, or in preſence of the perſon injured.

AMENDMENT, in a general ſenſe, denotes ſome alteration or change made in a thing for the better.

Amendment, in *Law*, the correction of an error committed in a proceſs, which may be amended after judgment, unleſs the error lies in giving judgment; for in that caſe it is not amendable, but the party muſt bring a writ of error. A bill may be amended on the file at any time before the plea is pleaded; but not afterwards, without motion and leave of the court.

Amendment of a Bill, in parliament, is ſome alteration made in the firſt draught of it.

AMENTUM, in *Botany*, the name of a ſpecies of calyx, conſiſting of valves, and hanging down in different

Amentum, Amerade. ferent directions from the caulis. Common oats afford a good example of the amentum.

Amentum, in *Roman Antiquity*, a thong tied about the middle of a javelin or dart, and faftened to the fore finger, in order to recover the weapon as foon as it was difcharged. The ancients made great ufe of the amentum, thinking it helped to enforce the blow. It alfo denotes a latchet that bound their fandals.

AMERADE, a kind of officers among the Saracens, anfwering to the governors of provinces among the Europeans. The name is originally the fame with that of Emir.

Amercement. AMERCEMENT, or Amerciament, in *Law*, a pecuniary punifhment impofed on offenders at the mercy of the court. It differs from a fine in being impofed arbitrarily, in proportion to the fault; whereas a fine is a certain punifhment fettled exprefsly by fome ftatute.

END OF THE FIRST VOLUME

DIRECTIONS for placing the PLATES of Vol. I.

Part I.

Plate	Page
Plate I.	Page 160
II. III.	228
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Part II.

Plate	Page
VI. VII. VIII. IX. X. XI. XII. XIII.	538
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ERRATA.

Page.	Col.	
175	1	line 38, for *the foundations*, read *some part of the foundations*.
295	1	— 21, for *Edward*, read *Arthur*.
374	2	— 13, for *Reith*, read *Beith*.

IN ALGEBRA.

Page.	Col.	
607	2	last two lines, for $-b^3$, read $+b^3$.
610	2	line 4, for $a+x^3$, read a^2+x^3.
611	2	— 30, for $\frac{1}{a^4}=\frac{a^2}{a^2}$, read $\frac{1}{a^2}=\frac{a^2}{a^4}$.
612	1	— 1, for $x^{-2}\times x^{-3}=x^{--3}$, read $x^{-2}\times x^{-3}=x^{-2-3}$.
—	2	— 37, for a^n+, read a^n-.
—	—	— 40, for $a-x$, read $a+x$.
613	1	— 9, for $\times\frac{z}{2}=6d^2z$, read $\times\frac{z}{3}=4d^2z$.
—	—	— 13, for $6d^2z$, read $4d^2z$.
616	2	— 13, for $\frac{5}{8}\sqrt[3]{2}$, read $\frac{5}{4}\sqrt[3]{2}$.
—	—	— 14, for $5\sqrt[3]{\frac{1}{8}}$, read $5\sqrt[3]{\frac{1}{32}}$; also for $\frac{17}{8}\sqrt[3]{2}$, read $\frac{11}{4}\sqrt[3]{2}$.
624	2	— 10, also line 12, for $-(3x+a)$, read $-(3x-a)$.
627	2	— 37, for $abc-ac$, read $ab-ac$.
628	2	— 42, for $x-7$, read $x=-7$.
629	2	— 52, for $v+z=p$, read $v+z=-p$.
630	1	— 3, for § 148, read § 147; line 18, for § 154, read § 153; and line 19, for § 153, read § 152.
631	—	— 5, for -20, read $-20x$.
—	2	— 22, for x^2, read $x^{\frac{1}{2}}$.
632	1	— 31, for $qx+r$, read qx^2+rx+s.
634	1	— 38, for *the first*, read, *the second*.
637	1	— 27, for $x-y+1$, read $x=y+1$.
638	1	— 9, for $+qa$, read $-qa$; and line 37, for b, read b^2.
—	2	— 25, 28, and 29, for cos. a, read $\frac{1}{4}$ cos. a.
639	1	— 2 and 5, for cos. a, read $\frac{1}{4}$ cos. a.
—	—	— 9, for cos. $a=\frac{r}{n^3}$, read cos. $a=\frac{4r}{n^3}$.
640	1	— 28, 29, 30, for $\sqrt{Ry}$, read $\sqrt{R}\,y$.
642	2	— 2, for $\frac{1}{x}$, read $\frac{1}{x^2}$.
648	2	— 14, for $\frac{1}{y}$, read $\frac{1}{y'}$, twice.
651	1	— 24, for $(+y)^{\frac{m}{n}}$, read $(1+y)^{\frac{m}{n}}$
660	2	— 2, for b read c.
665	2	— 4, $8q^2+p^2$, read $8q^2-p^2$.
667	1	last line but four, for AC$=a$, read AC$=b$.
669	2	line 8, read, *if* AK *be taken* $=a+c$, *the ordinate* K4 ....
674	—	— 7, for cos.$^2a+\ldots$, read $c'=$cos.$\,a^2+\ldots$
—	2	last line but six, for y^2, read y^3.