APPENDIX

TO

THE GENERAL REPORT

OF THE

AGRICULTURAL STATE, AND POLITICAL

CIRCUMSTANCES,

OF

SCOTLAND.

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OF

SCOTLAND.

DRAWN UP FOR THE CONSIDERATION OF THE BOARD OF AGRICULTURE AND INTERNAL IMPROVEMENT,

UNDER THE DIRECTIONS OF

THE RIGHT HON. SIR JOHN SINCLAIR, BART.

THE PRESIDENT.

VOL. II.

"*Knowledge is Power.*" BACON.

EDINBURGH:

Printed by David Willison,

AND SOLD BY ARCH. CONSTABLE & CO. EDINBURGH: AND LONGMAN, HURST, REES, ORME & BROWN, LONDON.

1814.

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APPENDIX

TO THE

GENERAL REPORT

OF

THE AGRICULTURAL STATE AND POLITICAL CIRCUMSTANCES

OF

SCOTLAND.

CHAPTER XI.

No. I.

OF THE EXTENT OF WASTE LAND IN SCOTLAND.

It would certainly be desirable to know, not only the total extent of waste land in every different county of Scotland, but also how much of that waste is capable of being cultivated; and what proportion it bears to the land now under improved cultivation. Such information, however, cannot be easily obtained: even the most intelligent Reporters on the rural economy of the different counties, have been able to do no more, than to form conjectures on that subject. Indeed it is impossible to state the amount, in any degree approaching to accuracy, unless actual surveys were made, not only of every county, but of every estate, and of every farm within the kingdom. The transition from cultivated soil of the best quality, to ground absolutely sterile, and to every intermediate stage between fertility and barrenness, is so frequent, and proceeds by such insensible gradations, that it becomes extremely difficult to draw the line between each kind, or to exhibit any accurate statement of the extent of every distinct quality of soil.

On the whole, the following Table of the fertile and cultivated, and of the uncultivated lands of Scotland, is perhaps as near an approximation to the truth, as can be expected, considering the present imperfect sources of information, regarding that important subject of inquiry.

Names of the Counties.	*English acres cultivated.*	*English acres not cultivated.*	*Total English acres.*	*Proportion in 100 cultivated.*
Aberdeen	451,584	802,816	1,254,400	36
Argyll, besides Islands	163,970	1,244,030	1,408,000	11
Ayr	325,830	339,130	664,960	49
Banff	123,840	288,960	412,800	30
Berwick	137,196	145,684	282,880	48.5
Caithness	92,333	347,347	439,680	21
Clackmannan	23,040	7,680	30,720	75
Cromarty	20,480	143,360	163,840	12.5
Dumbarton	53,990	91,930	145,920	37
Dumfries	232,557	569,363	801,920	29
Edinburgh	145,000	81,560	226,560	64
Elgin	121,088	181,632	302,720	40
Fife	209,216	89,664	298,880	70
Forfar	369,408	198,912	568,320	65
Haddington	139,264	34,816	174,080	80
Inverness, besides Isles	148,685	1,709,875	1,858,560	8
Kincardine	92,416	150,784	243,200	38
Kinross	27,648	18,432	46,080	60
Kirkcudbright	168,243	357,517	525,760	32
Lanark	271,296	331,584	602,880	45
Linlithgow	57,600	19,200	76,800	75
Nairn	37,440	87,360	124,800	30
Peebles	24,500	179,660	204,160	12
Perth	501,118	1,126,298	1,627,416	32
Renfrew	72,000	72,000	144,000	50
Ross, besides Islands	120,378	1,187,678	1,307,856	9
Roxburgh	205,920	251,680	457,600	45
Selkirk	10,100	158,220	168,320	6
Stirling	195,600	117,360	312,960	62.5
Sutherland	63,045	1,059,515	1,122,560	5.6
Wigton	101,136	187,824	288,960	35
Buteshire	29,440	73,600	103,040	28.6
Argyll Islands	107,020	487,540	594,560	18
Inverness Islands	95,680	640,320	736,000	13
Ross-shire Islands	30,117	328,283	358,400	8.4
Orkney	24,480	247,520	272,000	9
Zetland	21,888	525,312	547,200	4
Total Scotland & its Islands	5,043,450	13,900,550	18,944,000	26.6

CHAP. XI. APP. No. 2.

INQUIRY CONCERNING THE ORIGIN AND NATURE OF PEAT-MOSS.

By JOHN NAISMITH, ESQ.

THIS substance has, of late, been the subject of much discussion; and various hypotheses have been advanced as to its origin, and perennial existence, while the greater number of vegetables spring up and perish in the course of one year. The little attention which had formerly been paid to the origin and progress of moss, rendered its great durability, a new phenomenon to those, whose attention it had excited; gave scope to their imaginations, and sometimes led them, perhaps, to adopt conjecture instead of truth.

Instead of attempting to combat any of the theories which have been advanced, it may probably be more useful, to leave every one to the enjoyment of his own; and exhibit, a few actual observations made on this substance, both in its incipient, and more advanced state, as more serviceable to sober inquirers in their future investigations.

And, first, with respect to moss in its incipient state.—There can be no doubt, that Infinite Goodness had originally endowed the surface of the earth, with a disposition to produce vegetables, suited to the support of the animals existing upon it. But perhaps all parts were not endowed, with an equal degree of fertility; and this inequality, is so greatly increased by the revolutions which are perpetually occurring, that some parts have become totally incapable of producing pasturable herbage. But beneficent Nature has provided a remedy for correcting this inequality. When any part of the surface is so barren, as not to produce those plants which penetrate the ground with their roots, and thence draw their principal sustenance, some of the coriaceous lichens and smaller bryums, which have no rostel to put down into the earth, but lay hold on the surface with their small fangs, and draw their support from the atmosphere, first occupy the ground. These, and others of the same nature, thrive the faster, in proportion to the abundance of water which may, by any means, be detained on the surface. When the supply of this liquid is considerable and lasting, cushions of the *Bryum hypnoides* begin to form over the others, and serve for dams to detain more water. The *sphagnum palustre* then occupies the hollows; and the *lichen rangiferinus* grows thick on every hillock: and thus all the parasitical tribes of *Musci* and *Algæ*, of which peat-moss is formed, grow over one another. In this manner, peat-moss begins to be formed on barren ground, in cold and rainy countries, and accumulates the faster, as the temperature is colder, and the water more abundant. Any attentive observer, who has passed over barren ground, neglected and undrained, must have noticed these beginnings, and need be at no loss to form a judgment, how this substance has, in the course of ages, while the culture of the fields was neglected, occupied so much of the surface. There is a piece of rising ground, in the midst of a large flow moss, where the writer of this has seen the naked sand and sandstones, fifty five years ago. He has, at different periods, observed the progress of growth over it, as above described; and now it is covered with from six to nine inches of peat-moss, surmounted with a growth of strong heath.

As soon as the parasitical plants have accumulated into a body of spongy matter, of such thickness, as to retain always abundance of stagnant water, other plants, to which it is now a congenial soil, take their station on it. The first of these are perhaps the two *Eriophora* (cotton heads), which are always found in the softest wettest parts. The *Scirpus cæspitosus* (deer-hair), soon succeeds, and communicates solidity to the spots which it occupies. The roots of this plant, penetrate deeper into the mossy substance than any other. These, and more especially the roots of the former, compose the substance which the makers of peat fuel call Ket, a substance of great durability. The *anthericum ossifragum* (yellow-flowering asphodel), is very frequent in soft wet moss; but its spoils are not distinguishable in the substance of peat-moss. These are the most constant and considerable companions of the parasitical plants, of which peat is formed. There are a number of others found on beds of peat, and no doubt tending to its increase; some of them constant, but forming an inconsiderable part; others, not necessary concomitants of the peat-forming vegetables, but sometimes contributing considerably to its increase. The chief of these last, is the *juncus squarrosus* (stool-bent), which, requiring a soil of a more solid consistence than pure peat moss, is found only on mosses, to which age, and a mixture of earth, conveyed by the agency of water, had given some degree of solidity; and, in such, it is sometimes a large ingredient.

Thus, the means by which Nature seems to communicate vegetable matter to those parts of the surface where it is wanting, and to extend and preserve the fertility of a country, is, owing to the neglect of man, converted into a misfortune, by this torpid substance being allowed to accumulate, beyond due bounds, and to become still more torpid, by long steeping in cold, stagnant water.

But though those parts of the surface, incapable of nourishing vegetables which feed by their roots, is the natural base of peat moss, this substance is formed over all soils, however fertile, when the power of exerting that fertility is obstructed. This is occasioned, either by fallen wood, or stagnant water, covering the surface; and over these, in the hollows of the country, the largest bodies of peat-moss are found. And this brings us to the consideration of this substance in its advanced state.

In those flats and hollows, where water is not quickly drained off for want of declivity, the *musci*, and their companions above mentioned, rapidly increase in bulk, and, retaining much water among the fibres, the surface is often so soft, as not to support the foot. By repeated heavy rains on this soft substance, the water flowing off, wears little channels, which gradually deepen, and render the face of the field somewhat drier. Then Heath, the congenial soil for which is an accumulation of the spoils of the *musci*, though it cannot grow where this substance is distended by a great excess of water, appears on the surface. The channels above mentioned are often choked up, the surface is overflowed, and the heath is killed. The *sphagnum* and its companions, now form a new stratum over the surface; and thus the mass is augmented, by alternate beds of those plants, which prefer a watery, and those which prefer a solid soil, forming over each other. These beds lie so distinctly, that if a perpendicular section of a moss, were fairly exposed to the weather for a year or two, a probable computation of its age might be made. But this only could be of such mosses as are of recent origin; for the years' growths, of ancient periods, are lost and confounded in one another.

To make some examination into the nature of pure unmixed peat-moss, in an advanced state, a moss was chosen, which, from its situation, promised to have the least extraneous mixture. It was surrounded, on three sides, by a range of low sandy hills, covered with short grass; on the fourth, by a plain, gently sloping down from the moss. It seems to have grown over a gentle slope. Where peat has been dug on the higher side, the remains of pretty large trees are found; on the lower side, no remains of trees appear; nor can those who dig peats there, get to the bottom of the moss, to which, being lower than the common declivity, the under water prevents access. The surface of this moss, is close set with little tufts, separated by hollows. The tufts or hillocks may occupy about three-fourths of the surface. The most conspicuous plants upon it, are the following;—the hillocks have almost every where been clothed with a thick covering of the *Bryum hypnoides*, grown to the length of eight or nine inches, and lying prostrate, but mostly lifeless, and a new growth beginning to appear on many of them. *Erica vulgaris et tetralix* (common and bell heather) growing promiscuously, very slender, and not above eight inches high, prevail on every hillock. Where the hollows are not naked, the *sphagnum palustre*, accompanied with several upright species of *Bryum*, is spreading, and even extending to the tops of the hillocks. Wherever there are any other plants, the *scirpus cæspitosus* and *eriophora* are also found. The *anthericum ossifragum* is every where frequent. The *lichen rangiferinus*, and often along with it, *L. subulatus*, is close set on every hillock, A few species of coriaceous *lichens*, cover the sides of most of these hillocks. These being the most numerous and bulky plants on the surface, it may be presumed, that they are the chief ingredients in the substance. A number of others, of smaller growth, or less frequent, are observable. The *lycopodium alpinum* is seen in scattered tufts. Beds of the *lichen cocciferus* closely stud many of the naked spots; and the *drosera rotundifolia*, is dropped up and down in similar places. A few others, less conspicuous, need not here be mentioned.

This minute description of one particular moss, will serve for a general description of pure unalloyed peat-moss, wherever it occurs, and is meant as such; for all the peat-mosses of this country, which have been examined, differ no further than, 1*st*, Having been longer in a decaying state, incidental circumstances having sometimes suspended their advance of growth, they become more solid by being more concentrated by the continued pressure of the atmosphere and their own weight, and by the progress of decay; and hence of a darker colour, the undermost and eldest strata being always the darkest: 2*d*, as containing a greater or less proportion of the other plants with the *sphagnum palustre;* which, as it makes the quickest progress, in wet places, is generally the principal ingredient, and long retains a lighter colour: and 3*d*, as the moss contains a greater or less mixture of extraneous substances.

The peat-moss under consideration, seems to have arrived nearly to its utmost state of advance, and is now making slower progress, it being almost surrounded by a range of perpendicular breasts, from which peat fuel is annually dug, by which adventitious water is cut off; but it is evident, its increase has formerly been very rapid. Where a section is exposed by the breasts just mentioned, the colour is of a light brown, variously shaded for six feet from the surface downwards; and afterwards it becomes gradually darker.

On the 8th July 1812, a box, measuring an exact cubic foot within, was filled with the substance of this moss, at 2 feet below the surface, and 20 yards from the above mentioned breast, of more than 8 feet deep. The weather had then been dry, and pretty warm for ten days. It weighed, exclusive of the weight of the box, 60 lib. 8 oz. avoirdupois. The water squeezed out of it by compression, filled, of the same box, 5.85 inches, and was grossly feculent.

	lib.	oz.	lib.	oz.
Computing the weight of this water at the rate of 62½ lib. per cubic foot, its weight would be			30	7
The compressed moss actually weighed - -			30	0
			60	7
This was thinly spread on a canvas, exposed to the sun, and frequently turned over for five hot days; but not being quite dry, it was toasted for some time before a fire, and weighed - - - - -			7	7
Of course, the weight of the water evaporated was	22	9		
And the water squeezed out as above -	30	7	53	0
			60	7

Thus the solid matter was something less than the eighth part of the whole mass; yet, when packed into the box, it occupied nearly three-fourths of its contents. To try the difference of solidity at different depths, on the 22d July, the box was filled at 5 feet lower in the moss than the last, and weighed 56 lib. 8 oz.

	lib. oz.	lib. oz.
And after the water was squeezed out of it, it weighed - - - -	50 8	
The expressed water, by calculation, should have weighed - - - - -	5 12	
		56 4
When the moss was dried by sun and fire, as before, it weighed 14 lib. 7 oz.; hence the water evaporated was - - -	36 1	
The water squeezed out, as above - -	5 12	
		41 13
Solid substance left - - - -		14 7
		56 4

Hence the solid matter is nearly one-fourth of the whole.

Of the feculent water of the first, three English pints were kept, to examine if it contained any kind of acid; but, being so grossly feculent, no accurate trial could be made, till it could be somewhat cleared, which was very difficult. When an attempt was made to filter it through paper, the feculæ settled on the paper, and retained the water like a bladder. By passing it through dry sand, with a thin linen rag under it, a small quantity of almost clear water was obtained. This had no acid tastè. A solution of the sulphat of iron dropt into it, made no change; it had not the least effect on the colour of paper stained with the juicy petals of blue flowers. Of course, the moss does not appear to have contained any acid. Here, however, a remarkable fact ought to be recorded. On the expectation that the feculence of the moss, with which the sand through which it had passed was visibly mixed, might possibly yield some nourishment to a growing plant, a flower-pot was filled with this sand, and another with the same sand without mixture, and a grain of barley planted on each. Both were regularly watered; both plants appeared, and continued nearly equal till the third leaf appeared; when that on the sand through which the moss-water had passed became flaccid, fell over, and withered, while the other continued erect. This unaccountable appearance gave surprise: the experiment was repeated—the result was the same. On a third repetition, the plant appeared stout and vigorous till it got three leaves; and then, all on a sudden, the middle leaf fell over as before; and it was concluded, that the mossy feculence had some unknown deleterious quality. But the flower-pots having been allowed to remain in their place, that part of the middle leaf, within the socket, had pushed vigorously forth, and the plant continued to thrive till it put forth two strong off-sets before it was removed. A little of this moss-water was evaporated, and the sediment appeared almost solely undecomposed fragments of the plants, lying loose and uncompact, and could not be formed in a mass.

The water expressed from the lower stratum of moss, seemed to adhere as rigidly to the feculence suspended in it, as the other. Accident, however, discovered a mode of separating them. A greater quantity of this liquid, having been kept than was thought necessary on the former occasion, a part of it was placed in a heat above 80° of Fahrenheit, to accelerate evaporation. After it had stood there for some time, the water appeared limpid, swimming above the feculent matter. It would seem, that such a degree of heat had enlarged the volume of the water, without affecting the mossy substance in the same manner. In this way, plenty of limpid water was decanted off the surface. When a solution of sulphat of iron was dropped on it, and paper stained with vegetable blue plunged in it, no change appeared in either case; nor did it give any sense of acidity when taken into the mouth. It was vapid water, resembling that found in rushy bogs, and left a slight clamminess in the mouth. It was observed also, that the skin, when wetted with the moss-water, felt slightly stiff as it dried, as if it had been a weak solution of gum or starch. When the evaporation was completed, the sediment lay compact; and working in the hand, formed it into a solid ball, which, after being dried, and plunged into a vessel of water, sunk to the bottom. Part of this sediment, before being fully evaporated, was poured round a young plant growing in sand, and seemed to promote its growth. Some small fragments of the plants were visible in this sediment; but the greatest part was disorganized matter.

Here it may perhaps be allowable, to suspend the narration of these little experiments, just to observe, that besides the vegetable ingredients of pure moss, it has perhaps an animal one, of no inconsiderable extent. In every tuft of *sphagnum*, in the above moss, which was opened, ants were swarming in thousands, with their larvæ along with them. This, too, is common to this substance in other places. A person who had several years ago filled a handkerchief with *sphagnum*, from a peat-moss more than 60 miles distant from the one in question, reports, that after it had been carried some miles, it was spread before a fire to dry; that thousands of ants, issuing from it, dispersed over the whole body of the person employed in spreading it, and bit him so cruelly, that he was obliged to fly, and shift himself, to get rid of those bitter bosom foes. This is a piece of natural history, of which, it is believed, hitherto no notice has been taken. Natural historians have described different species of ants, expatiated on their political economy, on their foresight and sagacity, and particularly on their skill in constructing magazines and habitations, proof against the rain and damp: But no description has been given of those swarms of careless Emmets, who live in a mire, without appearing to provide any other food or lodging than what the mosses, growing upon it, afford them. Such multitudes of short-lived insects, brought forth, and dying, where all substances are long preserved, must contribute somewhat to the bulk of the mass. It might have been expected, therefore, that the formic acid would not have escaped those chemists, who have so fondly expected to discover vegetable acids in peat-moss.

But to return to our experiments.—It having been reported, that the late celebrated Dr Black found that moss-water had the quality of preserving substances immersed in it from corruption, two fresh oak leaves were sunk in a vial filled with the water obtained as above said, which was close corked up. At the end of a week, the leaves were become flaccid and discoloured, and the water very fetid.

Ten ounces of both the upper and under portions of the moss, after being fully dried, were separately submitted to combustion. The upper appeared to consist entirely of fragments of the plants little corrupted; was of a light-brown colour, and lay loose and unconnected. A small part of it was inflamed by a lighted candle, put on an iron plate, and the remainder laid round the inflamed part in small portions at a time, as the former were consumed; and thus the whole was consumed in a short time. The under consisted of a mixture of undecayed fibres and disorganized matter. A great part of it, formed into little balls like peas, was of a darker colour than the other, and not more than half the bulk. It was ignited with much more difficulty; and when more was added, the fire was extinguished. After repeated unsuccessful attempts to keep the inflammation alive, the iron plate was placed over a coal fire; and when it heated, the moss was consumed by laying it on in small quantities as before. The residue of both was white ashes: the only apparent difference was, that the ashes of the upper peat lay light and feathery, the other more compact. When both were divested of unconsumed matter, the weight of the lower, was to that of the upper, as 5 to 4.

A quantity of both the upper and the under were separately boiled for an hour in lime water. This made both of a darker colour, and less bulky; the fibrous parts were not decomposed, but more weak and brittle. A part of the liquid, squeezed from the moss after boiling, was gradually poured round the roots of a young plant, and evidently promoted a more vigorous growth. The colour of the moss was also darkened, and its fibres weakened by steeping a week in cow urine.

The lower side of this moss, which has probably been first formed, should be in the most decayed state; but the bottom or oldest strata are not accessible, as the water rushes furiously out, on those who attempt to take up the bottom peat. A small piece of this, however, was procured. When thoroughly dry, it was as hard and as brittle as a bit of pit-coal, though not of such a clear black colour. By friction, its surface assumed a kind of polish. When plunged into a vessel of water, it sunk, and one corner rested gently on the bottom. It seemed to have little affinity with water. After a piece had lain in the water for a day, the water was not discoloured, and the peat but a little softened, and that only externally. Though it appeared a mass of rotten matter, the microscope showed some whitish undecomposed fibres in it. A part was put into a fire, and it submitted to ignition, with as great reluctance as the hardest pit-coal; but when fully ignited by the force of the heat around it, it burnt with a pretty brisk white flame. When lifted out of the fire, in this state, and placed on the hot iron plate at the side of the grate, the burning ceased, and could not again be revived till it was replaced in the middle of a coal fire. This, and the former experiment by fire, prove that the hypothesis of the late learned Dr Walker, which holds forth, that peat-moss, the farther it is advanced in corruption and decay, becomes more bituminous and inflammable, is altogether without foundation. The ashes, like the former, were white, and seemed to be in considerable quantity, in proportion to the bulk burnt; bnt the precaution of burning it in a tight vessel, not having been taken, the exact quantity could not be ascertained. The whole quantity procured, being very small, and the season far advanced, no experiment could be made on what effect it would have had in promoting the vegetation of land plants.

But though pure undulterated peat moss is, as has been stated, the same in all cases and situations, varying only according to its age, the pressure it has undergone, and the proportion of the different plants of which it is composed, it is not always found thus free of foreign mixtures; and varies also, according to the quantity and quality of the substances with which it is mixed. The springs which flow into it, frequently contain some mineral substance in solution, part of which they deposit in the moss. Thus, if lime or selenite is dissolved in the water, the moss will have some mixture of calcareous earth. Some peat fuel, emits a smell of sulphur in burning, which indicates that the water passing through it had left that substance. And iron, being very generally diffused near the earth's surface, many springs are loaded with it; and hence the ashes of peat, tinged with the oxide of that metal, are often of a red colour. But the largest mixture, and the one which has the most important effects, is that of the earths, carried repeatedly over the surface of mosses by land floods, from the higher grounds. When there is a large extent of high ground, declining towards a flat moss, the influx of water being considerable, it lays the earth it brings along with it, on the edges of the moss, with every flood; and, making gradual advances, sometimes covers the whole with the mud which it deposits. After this mud is increased to such a thickness, as to consolidate the moss, the parasitical plants, and their companions, by which moss is formed, perish, and land herbage succeeds, less or more agreeable to pasturing animals, as the surface is worse or better freed of excess of water. As the simple unmixed moss above described, is the most useless, so this is the most valuable, for the different purposes of rural economy. From its bowels a solid, warm, and lasting fuel may be obtained. When exposed for some time to the weather, it makes an excellent ingredient of compost manure. Its surface is easily converted into valuable meadow or pasture; and by proper culture, is capable of yielding plentiful crops of roots or corn.

As a contrast to the former, some description of a peat moss of this last kind shall here be given, by which some judgment may be formed of the intermediate gradations between the two.

For this purpose, a low moss was chosen, about three miles distant from that before described. It is situated in a narrow valley, between two ranges of high land. It appears to have been originally formed over a lake; for the water rising from below, will not suffer those who dig peat for fuel, to go beyond a certain depth; and the declivity of the country, does not admit of that water being drained away. The moss is certainly of considerable depth, as a pole of 12 feet long did not reach the bottom. In a perpendicular section of this moss, a mixture of its earths is seen, more than 10 inches under the surface; and, for the uppermost 6 inches, there was little mixture of moss. The surface has a thick cover of land herbage, very sweet on the dry places, and coarser in the watery hollows. The moss must be very ancient: for there are the marks of trees, which have been planted on its present surface, grown to a considerable size, and now gone. The box above mentioned, was filled with the black peat, about 4 feet under the surface, and weighed 61 lib. 14 oz. Exactly 4 lib. of this was weighed, and exposed to dry; for little water could be squeezed out of it by compression: and this water, when submitted to all the forementioned tests, contained no more acid than the former. The 4. lib. of peat, when fully dried, weighed just 1 lib.; and the weight of the whole, divested of water, would be 15 lib. 7½ oz. It would have been desirable, to have made a number of experiments on this anomalous substance, in all its various conditions, and with different mixtures, to try if, by any means, the true cause of its natural sterility, and the moſt practicable mode of correcting it, would be diſcovered. But the ſeaſon was too far advanced, for carrying theſe proceſſes to a proper extent, or to bring them to a final iſſue. If Heaven be pleaſed to prolong the life of the writer for another ſeaſon, he means to employ his beſt endeavours, on this important exploration: if not, it is hoped that ſome other will aſſume the taſk. It is one ſtep, at leaſt, to have expoſed the popular errors on this ſubject, which are ſo prevalent at preſent. A ſurer foundation is thus cleared for farther inveſtigation. In the mean time, it may be proper to record the following ſmall experiment, though the reſult be not concluſive.

On the 5th September, one flower-pot was filled with the upper ſtratum of moſs, which had been dried as before narrated, and afterwards ſoaked for near ſix weeks in cow's urine, and marked No. 1.—No. 2 was filled with the two parcels which had been boiled in lime water; there not being enough of either to fill the pot. No. 3 was filled with the above upper ſtratum of moſs, intermixed with ſtrata of fine pit ſand; the ſand being about the ſixth part of the bulk of the moſs, but perhaps more than the whole weight. No. 4 was filled with the above upper moſs unmixed. Grains of wheat were planted on all the four, and they were placed on the outſide of a window, facing ſouth-eaſt, in the open air, but under ſhelter of the eaves of the houſe. They were all gently moiſtened; and kept regularly ſo. The plants came up unequally, owing, it was thought, to ſome defect of the ſeed; but on the 1ſt of October, there were three living plants on each, moſt of them in the ſecond leaf. As the plants were hitherto fed by the farina of the ſeed, it is not to be ſuppoſed that they derived any ſuſtenance from the ſubſtance in which they grew. After dark, on Saturday the 3d, a furious ſtorm of wind and rain from the ſouth, came on, and continued all Sunday. On Monday morning, the contents of all the pots were almoſt floating with the water, from the eaves continually pouring upon them; and the plants were beat down cloſe to the ſurface. They were then brought into a room, and expoſed to the light, to try if they would recover, as the exceſs of water drained away. One plant on No. 3, was the only plant which recovered, and made any progreſs; the reſt either periſhed entirely, or continued weak and ſhrivelled to November 10th, when, on examination, they were found as follows; —The contents of No. 1, about ten days before, was ſwarming with ſmall caterpillars, and more minute creeping vermin, the progeny, no doubt, of winged inſects, which the ſmell had invited to lodge their ſpawn there. They were now all gone. Two plants were ſtill ſtanding, but weakly, and the leaves rolled inward; the roots were few, weak, and ſhort; looking as if they had been bitten. On No. 2, there were alſo two living plants, weakly, and the leaves narrow, but not ſo much rolled inward as the laſt; the roots were very little different from the laſt, but had rather a leſs ſickly appearance. One plant on No. 3 was greatly ſuperior to all the reſt; it had four leaves, whereas none of the former had more than two, and theſe, though not very broad, were long, and fully expanded; it had two main roots, near two inches long, with a number of ſhort ramifications coming from their fides. No. 4 had one plant, which came nearer to the laft than any of the reft; it had three leaves, not so broad nor fo long as the laft, but as well expanded; one root, longer and thicker than the last, went to the bottom of the pot, without ramifications from the fides; it refembled the roots of grain growing in a poor fandy foil.

No certain conclusion can be drawn from this little experiment. It is in vain to attempt to account for the ill success of the plants in the pots No. 1. & 2.: There being a suspicion of the seed being defective, it is hard to say, whether the soil or the seed was in the fault. From the appearance of the plant in the pot No. 4 it should seem, that peat-moss, while its ingredients still remain undecomposed, is not, of itself, hostile to the vegetation of land plants; since, when disengaged of the excess of water, and its parts forced nearer together, by compression in the flower-pot, a plant made regular, though slow progress in it, for more than seven weeks. But at the same time, this substance yields very little nourishment to such plants, since the advance of this plant was very slow, and its roots showed the symptoms of growing in the most sterile soil. The more vigorous growth of the plant, growing in the pot No. 3, indicates that the same substance, when mixed with more solid and heavy bodies, yields nourishment to land plants.

Though the foregoing examination of peat moss does not give ground for many certain conclusions, yet it may justify the following.

1st, This substance does not lose the organization of its ingredients, by the quick putrefaction which other vegetables, the growth of short periods, undergo; but rots, or is decomposed in a slow manner, analogous to the decay of perfect wood. And it is evident, that pure peat-mosses are always in an undecayed state, near the surface, as they annually acquire a new stratum, unless some incident have formerly put a stop to their progress.

2d, This resistance of putrefaction, which disqualifies the upper strata of peat-moss for yielding nourishment to land plants, cannot be attributed to any acid, or other substance, contained in the moss, but to the original construction of the plants of which it is formed, and their great elasticity, by which they are kept at a distance from one another, leaving large interstices, to receive water, which stagnates there.

3d, It appears, by what is above stated, that undecayed moss, is specifically lighter than water; that, as it is more decayed, it diminishes in bulk, and gains in specific weight, till it is altogether disorganized, and becomes a solid mass, and then its specific weight is rather more than that of water: consequently, as it decays, part dissolves in, and is carried off by water, leaving the earth behind, by which the specific gravity of the residue is increased. Hence, peat-moss is, at least in part, in its progress towards disorganization, soluble in water, and may nourish growing vegetables. This is confirmed by the valuable discovery of Lord Meadowbank, which now proves of general use to husbandmen.

4th, It appears by the experiment on flower-pot, No. 3, that a mixture of earthy substances, accelerates the decomposition of undecayed peat-moss. And this only confirms what may be often seen, where land-water has deposited earth on the edge of a peat-moss, or where earth has been laid on moss for its improvement, where the great increase of fertility could not possibly proceed from the earth alone.

But curiosity is more excited than satisfied by the above; and the following queries are naturally suggested.

Query 1st. Since peat-moss, which covers so much of the surface, is so useless in its natural state, what is the cause of its hostility to the roots of every kind of plant esteemed valuable to society? Is it the elastic quality of the fibres, by which they are held asunder, or the great quantity of stagnant water retained in the interstices, or both?

Query 2d. Is there any practicable mode, by which these defects may be corrected at a moderate expense? Can the fibres be compressed, and the interstices filled to any profitable purpose?

Query 3d. Since the upper strata of peat-moss remain undecomposed, and consequently incapable of nourishing land vegetables, whether would it be most advantageous, to use means to accelerate the decomposition; or—to remove the upper and least decomposed, in order to get at the more decomposed below?

Query 4th. If the former be used, whether do such as tend to give solidity, or such as increase porosity, appear most eligible?

Query 5th. If the latter be used, water and fire being the only known agents, and the cases where water could be advantageously used, rare, how can the upper part be best consumed by fire? The turf of the *scirpus cæspitosus*, and some others, is bound in large clods, scarcely capable of being sufficiently dried for combustion, in a moist atmosphere, and lying on a damp bed, in any summer: Will time, and any additament, overcome this difficulty?

Query 6th. What would be the result of consuming part of the surface of peat-moss? Is the cinder, or scorched part, soluble in water, as some have shown? Or insoluble as water-gravel, as others have asserted?

Other queries may be suggested; but probably the above are the most important.

It was thought proper to state, very minutely as above, every thing which occurred, in this examination, that nothing might be omitted, from which any useful deduction might be made.

CHAP. XI. APP. No. 3.

ON THE DRAINING OF FLOW-MOSS.

By Mr WILLIAM AITON of Strathaven.

DRAINING is certainly the first operation towards the improvement of moss. Until the surface is relieved of stagnant water, it would be worse than being idle, to apply manure, and vain to expect the growth of grain, or any valuable herbage.

The generality of those who have written on the improvement of that species of soil, have inculcated the necessity of draining, under-draining, trenching, &c. to render the moss dry. Some who have become practical cultivators of that soil, have expended vast sums in opening main-drains, master-drains, cross-drains, under-drains, &c. intersecting each other at right angles, in some instances within a few yards, and in others within a few feet of each other, in order to render the moss dry and solid. Some have used stones, some wood, and others sod, in forming the drains. And Doctor Anderson has recommended, to dig up the moss, the depth of two spadings; laying that taken from the surface, with the heather, &c. undermost, so as to give vent to rain water that falls on the moss, and lead it into the main-drains.

If draining of moss, in order to render it productive of grain, were necessary to the extent that those intelligent writers and industrious improvers seem to think, the plans of executing the drains, which they recommend, are certainly the best that can be invented. But there has been some diversity of opinion, among the cultivators and those who have written on the subject, as to the extent of draining that is necessary, on that species of soil.

Mr Aiton, who has seen almost daily, for near thirty years past, the mode of labouring and cropping the moss at Strathaven, and who has often surveyed, for many years past, the greatest improvements in the principal shires of Scotland, is decidedly of opinion himself, and avers that the most experienced cultivators concur with him, that the only draining that is necessary, on that species of soil, is, to open courses for the ready escape of all the springs that rise under the moss, or on its verges, and for that of rain water that falls on the surface; but that all farther draining, so far from being necessary, would, if it had any effects, prove injurious to the cultivated moss.

After admitting that flow-moss is too soft, and too wet in winter, he argues that it is often too dry in summer, for the growth of grain, or even of rich grasses: and adds, that he never saw a moss, on the surface of which, furrows for the escape of rain water had been made, and courses opened for springs to flow, where the crop was injured by too much moisture: but, on the contrary, that he has seen many instances of the crop being hurt, and sometimes altogether lost, for the want of moisture. According to his statement, all the cultivators of moss, of the greatest experience, have found, and now acknowledge, that under-draining is not necessary; and many of them have filled up the drains which they had cut, at great expense.

The ingenious Mr Naismith notices, that the crops on moss land, fail first on the sides of ditches, and places elevated above the common level; therefore recommends to lay on clay or earth on such places, to prevent the drought from penetrating. He thinks, that even the Ayrshire mode, of giving the ridges a high convex form, is improper, as the crop usually fails in the middle of these high ridges; the soil being too loose, and parched by the summer's drought.

No draining has ever been attempted, on any of the improved mosses at Strathaven, Garnkirk, Gartsheugh, Paisley, Hartfield, Riccarton, Rednock, Duntroon, and others described by Mr Aiton, except opening outlets for subterraneous springs, and channels for the speedy escape of surface-water; and none of these mosses (though all of them are of great depth, level, and originally very wet) have, after being reduced to proper form on the surface, been in the least injured by moisture. On the contrary, in Paisley moss, where a greater number of deep furrows had been opened, than are usually done in Scotland, they were found to be hurtful, and have been filled up.

Moss is no doubt softer, and takes in more moisture, than any other earth; but it also dries sooner, and to a greater depth, than any other species of soil. The drought will penetrate farther into a soil of cultivated moss, in one day, than it will do into those of clay or loam in six days. The consequences are, that a few days of severe drought, in the early parts of summer, or even when the grain is ripening, is sometimes fatal to the crop on moss. Whenever a severe drought happens at the time moss corn is ripening, it does not fill, as the farmers term it; but becomes white, without forming grain. This is what, Dr Anderson says, is termed *witched corn*, in Aberdeenshire. Even in seasons ordinarily damp, the crop is lost, or becomes *witched*, on the verges of ditches or deep drains in moss ground. All this, Mr Aiton avers, proceeds from the want of moisture. The same thing, he says, may be seen in every cultivated moss, where any little height is formed. This he adduces as an evidence to prove, that cultivated moss ought not to be under-drained. The great difficulty, he thinks, in cultivating that species of soil, is, not to render it dry, but to keep it from being too dry.

Where the flow is nearly level, and of course very wet, a few open casts, from one to two feet deep, may be cut at every 50 or 100 yards from each other, a year or two at least before the moss is laboured: and when the ridges are afterwards formed, the furrows, about ten or twelve inches in depth, may be made to empty themselves into these deeper drains: and, if streams of water run through the flow, a cast still larger and deeper may be cut, to receive it and the water from the other drains. In all cases, he observes, drains of some kind or other must be opened in sufficient number, and of proper dimensions, to carry off every drop of stagnant water from the surface of the moss. If the moss be nearly level, these drains or channels must be deeper and more numerous; but if the field has declivity sufficient to facilitate the escape of moisture from the surface, no other draining is necessary, or can be of the least use, except to form the ridges from 30 to 50 feet broad, raise them eight or ten inches in the centre, make their surface as regular as possible, free from heights and hollows, the furrows a foot wide, and eight or ten inches deep, with proper and uninterrupted outlets. Draining to that extent, he says, is indispensably necessary; but all farther draining is labour lost; and trenching is injurious, in rendering the moss soil too dry.

Chap. XI. Appendix, No. 4.

On Flooding Waste Lands.

By the Rev. R. Rennie, D. D. Minister of Kilsyth.

Of all methods of reclaiming waste lands, flooding is one of the most expeditious and the least expensive. Though practised to a great extent over the continent of Europe, it has seldom been attempted in Great Britain; and I know of no Treatise on that subject in any language.

The following Essay is therefore submitted to the Board of Agriculture. The novelty of the subject, it is hoped, will secure their indulgence, and plead my excuse, for any errors that may occur.

The following are the general outlines of this Essay.

Section I. Evidences of the salutary effects of flooding waste land;

——— II. The plan to be adopted in flooding waste land;

——— III. The manner in which flooding operates;

——— IV. All kinds of water, not equally adapted for this purpose, and which are the best;

——— V. We have it often in our power to improve the quality of the water used;

SECTION I.

Evidences of the Salutary Effects of Flooding Waste Lands.

It is only necessary to name these; for they are so palpable, that every attentive observer must have noticed them: In every moor and moss in Britain, they may be observed.

First, Wherever a spring bursts out in any barren waste, it either forms a quagmire, or gently overflows a part of the surface. In either case, the surface thus overflown may be distinguished at a distance by the deep verdure of its herbage.

Secondly, Wherever a rivulet occasionally overflows the surface of any moor or moss, the coarse and useless plants disappear, and soft meadow grasses, or sweet herbage, occupy their place. Dr Smith of Campbelton mentions a case of this kind, which is of very common occurrence. "In travelling over the face of a black mountain, about 30 years ago, my attention was arrested by a green strip which runs across the heath for the space of half a mile. The striking contrast between it and the rest of the ground, induced me to go to the spot, and examine into the cause of this difference. I found that it had been the lead or track by which water had been once conducted to a corn-mill: When it had been cut, or how long it had been empty, I know not; but the very bottom was covered with soil and grass. The effect of the watering continued still; and for a considerable space below the lead, or drain, where the water had overflowed, the surface was thus ameliorated."

Thirdly, The same effect of flooding may be seen on a more extended scale along the banks of large rivers, especially in low-lying plains occasionally overflowed: though the whole surface consists of moss, yet over all the extent of soil which is thus occasionally covered with water, a rich crop of meadow grass may be seen. The subsoil of such land is still moss; but the surface, by the overflowings of such rivers, is converted into meadow land.

Fourthly, Not only have most of the meadows been thus reclaimed; but it appears more than probable, that all the alluvial lands along the banks of rivers, have been formed by similar means.

That these lands were, at one period, barren mosses, appears from the following facts:—that the subsoil still consists of this substance—that small patches of moss, like little islets, may still be seen over the surface—that these patches are so high above the rest of the field, that they have not been overflowed—and that these alluvial lands have been formed by the adjacent rivers, is beyond a doubt. Hence all this rich and fertile soil, consists of all the varieties of earths over which such rivers run in their course. Sand, clay, and calcareous earth, and many most valuable salts, are thus deposited in these extended levels, by the overflowings of rivers. Thus the richest composts of alluvial soils are formed.

Lastly, Wherever water is allowed to stagnate over the surface of any moss, it undergoes a similar change by similar means. This may be seen in many mill ponds, and artificial sheets of water. They are frequently formed over the surface of low, level, mossy lands.

If these ponds were to continue always full of water, in a stagnant state, without any springs running into, or issuing from them, they would soon be filled up with new formed moss; and in the course of ages, these lakes would disappear: * But as they are occasionally full and empty by turns, and as there is a constant influx and efflux of water running though these ponds, no new moss is formed in them; and the aquatic useless plants, which formerly flourished on their surface before it was laid under water, are checked in their growth. In a few years, they decay and disappear altogether; and if such ponds are laid dry and drained, they will form an excellent soil, though formerly sterile moss.

These are a few evidences of the salutary effects of flooding waste lands; they are like the voice of Nature—pointing out the very plan we ought to pursue in reclaiming such soils; but though that voice has been loud, and long heard over all the British empire, it has seldom been listened to. Of course, this method of reclaiming waste lands has seldom been attempted; nor has any author pointed out the plan we ought to pursue;—that plan is simple. *Follow Nature* † in this, as in every other process. Mark the silent and slow, but steady and irresistible operations, that are going on over the face of the earth. By imitating these, and lending our feeble hand to aid them, we can-

* The precise process by which this is accomplished, is stated in Dr Rennie's Second Essay on Peat Moss.

† *Nature* is an ambiguous expression; it is sometimes used in a sense that cannot be justified. In this Essay, it is to be understood, as expressive of those laws established by the *Great Creator* for the preservation and government of the material world. In this sense alone, it is to be understood by the reader, and in this sense alone, it is justifiable. If another mode of expression occurred to me that was equally explicit and short, it would be used; but the best writers have used it in the sense above pointed out, and therefore it is retained.

not err: That it is in our power both to aid and imitate them, will appear from the following Section.

SECTION II.

The Plan to be adopted in reclaiming Waste Lands by Flooding.

As both running and stagnant water operate in reclaiming waste lands, we have it in our power by both to imitate the process, which we see perpetually going on; and we can also lend the feeble aid of art to expedite that process where it is already begun.

First, In low-lying level wastes, it is frequently in our power to accomplish this at a small expense: all that is requisite for this purpose, is a command of water, and an opportunity of stemming it up, so as to overflow the whole surface. In many places, such situations may be seen over the surface of the united empire; all land-locked mosses that lie on a level lower than adjacent springs or rivers, are of this description. In many places, 200, 300, or 400 acres of such mossy lands, may be laid under water by a single bank at the outlet, which will not cost as many shillings to form it. By shutting up this opening, or stemming a small stream, this may be accomplished. *

Secondly, But few mosses or waste lands are entirely level; in most of them there is a slight or considerable declivity. In all such cases, a different plan must be adopted. If the declivity be considerable, it is clear that one bank will not suffice to lay the whole surface under water. To form such a bank, would be expensive; besides, it would be apt to give way by the weight of water. To obviate this difficulty, the following simple plan is suggested. In place of forming large banks across the declivity, narrow strips of undug moss ought to be left in that direction. They will serve the purpose of banks; for no substance is more impervious to water than undug moss; and as the ridges dug between these strips will subside by cropping and cultivating them, these strips will form natural banks to stem the water sufficiently to cover the cultivated ridges between them; especially if the ridges be narrow, and the strips of undug moss numerous, in proportion to the declivity of the surface. The water being let in from above, will be stopped in its course downward by these undug strips.

If the ridges be pared and burnt in the first instance, and then sown down with grass, and flooded afterwards in the manner now described, the whole surface may be converted into meadow, and by the same means be watered afterwards; or, if it be more expedient to cultivate and crop the whole field, all that is requisite,

* The mode of conducting this operation in level mosses, will be fully stated by Dr. Rennie, in his Essay on the subject of Flooding Peat Mosses.

is, to pare and burn the undug strips which formed the banks, and crop them along with the rest.

Thirdly, In many cases, waste lands lie on such a considerable declivity, that it is impracticable to lay them under water by the plan now described. A current of water, however, in such cases, will serve the purpose. If properly directed by small ruts, so as to overrun the whole surface, it may be reclaimed and rendered productive, at least of grass, by this means alone.

J. Cochran, Esq. of Ladylands, succeeded in reclaiming some waste lands by this means in Ayrshire. He turned a mountain rill over it: though formerly almost sterile, or at least productive only of the coarsest and most useless herbage, in a few years it became highly productive. From 11 acres of that waste, which was not worth four shillings an acre in its original state, he reaped no less than 4500 stones English of excellent hay.

Lastly, Where water cannot be had on a level sufficiently high for these purposes, it may be raised in some cases by machinery. This plan, however, is so expensive, that it will seldom be adopted.

But there is one case in which a machine of ample power for this purpose is already erected: it was indeed originally intended, and is still used, for far other purposes than flooding waste lands. The celebrated Lord Kaimes, formed the magnificent plan of washing off his moss altogether by this machine; and the ingenuity of the invention, the patriotic spirit he displayed, and the success of the attempt, will be a lasting monument to his honour.

But that powerful machine might be turned to another purpose; and the water now used for carrying off the moss as a nuisance, might serve to reclaim it as a soil. If properly directed over the extensive surface in the manner to be hereafter described, it might be reclaimed at one-tenth of the expense, while the mossy subsoil might be reserved as a fuel or manure for future generations.*

As this plan will appear fanciful to the public, and probably never will be adopted by the proprietor, the following hint is suggested:—it may be of use. There are seasons when the moss cottagers cannot work, especially in rainy weather; at these times there is the greatest command of water, and much is allowed to go to waste. If, in place of this, all the water were collected into one stream, and carefully directed over the surface of the moss, it might be consolidated and converted into good pasture, by this means alone.

But the following plan would still be preferable:—If the surface were pared and burnt, and planted with fiorin in the first instance

* The industrious Dutch adopt this plan with great success: the mode they follow shall be described in Dr Rennie's Essay on the subject of Flooding Moss, in order to convert it into meadows.

—and if the waste water were afterwards used in the manner now mentioned to flood this meadow—when thus formed, it would become more fertile, and produce a richer crop of hay, than any part of the subsoil, which is now laid bare and cultivated.

The laborious, and active race of cottagers already settled on the spot, would be the fittest instruments to employ for executing this plan. It would, besides, furnish them with sufficient employment at those seasons, when their other operations are at a stand. To the benevolent proprietor, this consideration will be of the greatest importance; the quantity of hay raised on the surface of the moss, would furnish winter fodder for the cattle of the cottagers, and by this means abundance of manure for the rich soil they have already reclaimed and laid open.

These hints are freely thrown out, not from want of respect to the memory of Lord Kaimes, or the present proprietor, but from the purest and most disinterested motives, a sincere desire to promote the interest of the proprietor, and the comfort of his numerous cottagers on that settlement.

SECTION III.

Of the manner in which Water operates in reclaiming Waste Lands.

As there can be no doubt that much waste land has been reclaimed by flooding, it would be very satisfactory if we could ascertain the manner in which it operates. The following hints are thrown out with this view: they merit the consideration of the public, merely because they may all be brought to the test of experiment. These experiments, too, are so simple, and attended with so little expense, that every farmer has it in his power to make them.

First, If a quantity of moss be dug up and spread out over any field, and frequently watered, it becomes fertile and productive, and may even be used as a manure, though in its original state it was sterile and unfit for any of these purposes. This renders it more than probable, that the juices which are the cause of sterility in that substance, are soluble in water when it is newly dug, and that by this means they are washed away.

If so, may not a current of water, carried over the surface of newly dug moss, operate in a similar way? And is it not more than probable, that this is one way by which water operates in reclaiming waste lands? Stagnant water must have a similar effect. The soluble ingredients of such a soil must thereby be dissolved; and when this stagnant water is allowed to run off *freely*, these ingredients must be carried along with it. *

Secondly, When moss lies on a pervious subsoil, such as sand

* See Dr Rennie's Eighth Essay, already published.

or gravel, that subsoil is uniformly impregnated with the bituminous oil and acids of the moss. This proves that these ingredients are partly soluble in water. Otherwise they could not be washed down into the subsoil. Now, as these two ingredients are certainly hostile to vegetation, is it not highly probable, that by digging and flooding moss, these are carried off, and such a soil rendered more fertile? And is it not equally probable that this is another way in which water operates in reclaiming waste land? May not all the astringent and antiseptic juices of such soils be thus carried off? And must not the vegetable matter they contain be thereby better prepared to undergo the putrid fermentation? Where that process is accomplished, must not such soils become highly productive? The more vegetable matter they contain in this state, the more fertile they must become.

Thirdly, Alternate moisture and drought, heat and cold, promote the disorganization of all vegetable matter exposed to their influence. And when these alternations are rapid and often repeated, no vegetable can long resist their operation. The solid oak will yield to such powerful agents, and be reduced to its elementary principles. Or rather these elements will be set free from their former combinations, and be prepared to enter into other combinations. In this new state, this vegetable matter becomes a fit soil for nourishing other plants.

Moss and many waste soils contain vegetable matter in a state of organization. And why has it remained so long in this state? Is it not chiefly because it has been buried under the surface, and never exposed to these alternations of moisture and drought, heat and cold?

When such waste lands therefore are dug or ploughed, and then flooded with water, both in cold and warm weather, must not the vegetable matter they contain be exposed to these alternations? Must it not therefore, like the hardier oak, be reduced to a state of disorganization, and form a mould like it fit for rearing other vegetables? And may not this be another way in which flooding operates in reclaiming waste lands?

Fourthly, Coal and some species of schistus are more analogous to some kinds of peat, than even the oak, or any recent vegetable. When these substances are newly turned up, they are hostile to vegetation. But when exposed to moisture and drought, heat and cold, and the alternations already mentioned, they crumble down into friable mould. When thus reduced, both coal and schistus form a soil fit for producing grass or grain. If however we lend our aid to these powerful agents, and pound down these substances, and water them frequently, we greatly expedite these changes. A piece of coal or schistus may be converted into soil in as few weeks by these means, as it would in as many years without such adventitious aid. May not digging and flooding a mossy or moorish soil, have a similar influence? Must not these changes which are requisite to render it fertile, be expedited in the same way? And is it not highly probable that this is another way in which water has operated on mossy and moorish soils, by the natural operations we see going on along the banks of rivers and rivulets?

Fifthly, Moisture greatly promotes the fermentation of vegetable matter. Or rather it is absolutely requisite in this process. For without it, that is, when vegetable matter is entirely dry, this process cannot commence, far less be completed. Whereas when a sufficient quantity of water is applied, fermentation speedily begins, and is carried on with rapidity. In some cases, it becomes so rapid that it cannot be distinguished from combustion. Indeed fermentation and combustion, are the same process. The former is slow, the latter more rapid. Still they differ only in degree, not in kind.

And in some soils water alone is requisite to render the fermentation so rapid, that it cannot be distinguished from combustion. For instance, some mosses and other soils contain such a portion of pyrites, that when they are flooded, or exposed to alternate moisture, and drought, they will become heated, and smoke, and sometimes even kindle into conflagration.

If this be the case, flooding may have a similar effect, and operate in the same way on such soils as paring and burning.

Sixthly, Flooding waste lands must on all the above accounts alter and improve their texture as a soil. The vegetable matter they contain being disorganized, the whole soil must collapse and be consolidated. Its particles being more reduced, must enter into closer contact and more intimate combinations. In short, such a soil must differ as much from its original state, as well made dung differs in its texture from that which is full of straw and newly turned out from the stall. Even the mechanical pressure of a body of stagnant water, must tend partly to consolidate a soft mossy soil.

But perhaps the chief way in which flooding operates in reclaiming waste land, is,

Lastly, By the adventitious matter which is deposited by this means on the soil; more especially along the banks of considerable rivers in time of floods. Particles of sand, clay, calcareous matter, and saline substances, are carried along by the current of rivers. Wherever they overflow their banks, this muddy water becomes stagnant; and thus depositing on the surface a rich compost of alluvial soil, consisting of all kinds of earth over which the river runs in its course, it must form a soil of all others the most fertile. Combining with the original surface over which it is spread, and impregnated with saline substances of the richest stimulating qualities, it must alter the texture and the qualities of such a soil, and improve it not for a time only, but for ever. Probably the greater part of readers will be disposed to ascribe the whole salutary effects of flooding to this cause. There can be no doubt, however, of the effects of flooding; it is left to the public to ascertain the causes, and to decide to which of the above named they may be chiefly ascribed. Probably all of them may be taken into the account.

SECTION IV.

All kinds of Water are not equally fit for this purpose.

IT may be of service to attend to this distinction, otherwise both money and labour may be thrown away in attempting to flood waste lands with water unfit for the purpose. To prevent this, it may be proper to point out those waters which can serve no good purpose, and then such as may be used with safety and success. In general, it may be observed,

In the *first* place, that most waters that issue from mosses, are unfit for flooding waste land; especially such as are impregnated with a considerable portion of bituminous oil. In place of improving, they must injure any soil over which they are permitted to run.

For a similar reason, waters that issue from any soil impregnated with pyrites, must be injurious. Many mosses and stubborn clay soils are of this description: the sulphur and sulphuric acid, with the metallic salts it forms, are generally vegetable poisons. Chalybeate waters, too, of all kinds, are unfit for flooding; and all such as are impregnated with antiseptic qualities of any kind, are of a similar description.

In the *second* place, all soft waters which wash well, or readily dissolve soap, will serve the purpose of flooding waste land. Spring water, if pure, may therefore be used with advantage; as a proof of this, we uniformly observe, that wherever it is permitted to overrun any part of a waste, the heath and coarse herbage disappear, and sweet pasture grasses occupy their place.

Muddy waters in general may also be used; but they are not all equally beneficial. Much depends on the earthy ingredients with which they are impregnated; sometimes sand, at other times clay; sometimes carbonaceous, and at other times calcareous matter, constitutes the ingredients of such waters; and for the most part, muddy water contains a portion of all these earths, though in general one preponderates more than the rest. Of course, different waters are adapted to different soils; if the water be impregnated chiefly with sand, or silicious matter, it will not serve a soil of the same description, though it may be of great service in a mossy or clayey soil. On the contrary, if clay forms the chief ingredient in the water, it is peculiarly suited to a sandy soil. Calcareous matter in the water, will improve any soil; and all these ingredients combined, will consolidate and enrich any loose mossy soil.

Monsieur Bertrand, who has paid particular attention to this subject, and made many ingenious experiments, observes, that petrifying springs have been found unfavourable for watering *pasture* and *meadow* grounds. He ascertained and assigns the reasons of this: the calcareous matter they hold in solution, occasions a partial or total petrifaction of the grasses which grow on the surface of such lands. The growth of these grasses is thereby checked, and they become unfit for the food of cattle.

But though waters of that description be unfit for such lands, they are peculiarly adapted to mossy soils, and waste lands of every kind. The calcareous matter they deposit, must not only consolidate, but operate as a powerful stimulating manure to such sterile wastes; and if the springs be powerful, a vast extent of such soils may be reclaimed by them in a very short time. Such a river as Velmo, (see Dr Rennie's Second Essay), might in a few years convert the most sterile moss or moor into a solid fertile soil.

Rivers, too, which run through, or near large and populous cities in their course, must be peculiarly adapted for the purpose of flooding moss or any waste land. The alkaline and animal matter, and saline substances, washed down by the common sewers, must render the waters of such rivers fertilizing to a high degree: it is certain, that more liquid manure has been washed away into the ocean, by the Forth and Clyde, the Liffy and the Thames, than would have reclaimed half of the waste lands of the empire, if it had been practicable to overflow them with those rivers. The rich meadows along the banks of the Thames below London, and in similar situations, have been reclaimed by the overflowings of rivers, enriched by these means.

SECTION V.

We have it often in our power to improve the Quality of Water for the purpose of Flooding Waste Land.

THE manner in which this may be done is obvious: and in many situations it is attended with so little labour and expense, that it may be accomplished with expedition and ease. As the adventitious matter which forms the mud of most rivers, operates powerfully in reclaiming waste land, we have it frequently in our power to increase the quantity of that matter, and render the waters more fertilizing.

First, With this view we ought first to examine the channel of any river before it be used for this purpose. If in any part of its course, above the level of the land intended to be flooded, a bed of sand, or gravel, or clay, or alluvial earth, be discovered, it is often easy, by altering the course of the river, or throwing in a quantity of these materials, to wash them down by the river in the time of a flood. By this means, they may be conveyed and deposited on the surface of any adjacent waste or moss below.

Secondly, But calcareous matter will operate still more powerfully. In the channels of many rivers, a bed of marl or shells, or soft lime, may often be discovered. By loosening these materials, or throwing them into the course of the river before winter, they may be thus conveyed over the surface of waste lands on a lower level.

Thirdly, To point out the particular situations, in which this may be done with ease and advantage over the British empire, is impracticable. Suffice it to say, that they are much more numerous than is generally supposed. Almost every river in Ireland runs through a bed of marl, or limestone gravel, in some part of its course. Even many of the copious springs, that rise up from the subsoil of their extensive bogs, are impregnated with calcareous matter, because that subsoil consists generally of the very richest marl. Of course, wherever they overflow any part of the surface of these wastes, a rich luxuriant crop of the sweetest meadow grasses may be seen. I have distinguished some of these spots, by their deep verdure, at the distance of several miles; and if a little care were taken to conduct these waters over the rest of the surface, the whole might be reclaimed, and rendered highly productive, at a small expense.

Along the whole fens of Lancashire, and in many parts of Westmoreland and Cumberland, the case is the same. Marl abounds in the course of most of the rivers of these counties; and there cannot remain a doubt, that the whole of these fens have been reclaimed by the overflowings of these rivers. For all the surface over which the waters have run, are now rich meadows, though the subsoil, to the depth of 10, 20, or 30 feet, be still barren moss: whereas, the higher parts of that great level which has never been overflowed, remain in their original sterile state. I examined this most interesting spot with peculiar care; and there cannot be a doubt, that a vast extent of waste land there may be reclaimed by flooding.

In many parts of Scotland, situations equally favourable for the purpose might be pointed out, especially in those counties where marl abounds. The quantity of water is generally sufficient; the mountainous and uneven surface of the soil, is likewise favourable for this purpose, at least more so than in a champaign country, like many parts of England. In the latter, we cannot always command water; in the former, we generally can, at a level sufficiently high for the purpose.

In the Highlands and Islands, particularly in those parts that are inaccessible, and at a distance from lime and other manures, flooding may be used to great advantage, and to a vast extent; especially in those counties, where marl and calcareous manures of any kind abound. Shell marl, composed of fluviatile, or fresh water shell-fish, may be found in the bottom of many lakes and mosses, on a high level, which might be washed down, to improve the lower waste lands and mosses. Marble earth, of a soft, white, friable consistence, may likewise be detected in the course of these rivers. Petrifying springs, too, abound in these regions: if any one or more of these materials be discovered, they might be washed down to the lower lying wastes and mosses to great advantage. By this means, the former might be converted into rich pasture, and the latter into fertile meadows.

Lastly, As alkaline and animal matter, and saline substances, operate so powerfully in reclaiming waste lands, we have it often in our power, to improve the water used for flooding, by a mixture of these materials. The very water that is allowed to run entirely to waste from the dunghills of Scotland, might be turned to account in this way; even dung itself, in many situations, cannot be turned to better purpose. In the pastoral districts of the Highlands and Hebrides, the plough is seldom used; cattle, and not corn, is the produce of these districts. The dung raised on such farms, is allowed to accumulate for ages, as a useless heap, or even a nuisance.

Whereas, if it were tossed into the adjacent streams, and agitated and broken—and if these streams were directed in their course in time of floods over the waste lands and sterile mosses on a lower level, it might be turned to great account; especially in reclaiming level mosses, converting them into meadows, and raising a quantity of winter fodder, which is so much wanted.

The contents of common sewers, especially in large cities, might be used for a similar purpose: some considerable towns are situated on so high a level, above the adjacent wastes, that these sewers might be turned directly over them. Where this cannot be done, in place of allowing so much liquid manure to run to waste, it might be collected into reservoirs made for the purpose: from thence it might be conveyed in close carts, or barrels, to the neighbouring waste lands, and thrown into the water with which they might be flooded. Surely there are many situations, where such a plan might be adopted, with economy and success.

SECTION VI.

The Season fittest for Flooding Waste Lands.

Much has been written, and many judicious hints have been thrown out, on the subject of flooding pastures and meadows, and the seasons best suited for this purpose. Experience, too, has suggested a variety of regulations for conducting this process; but it is obvious, that these regulations do not apply to flooding of WASTE lands. On the contrary, the rules for flooding the latter are generally the reverse of the former.

First, In flooding meadows, if water be allowed to stagnate long on the surface, the roots of the valuable grasses are injured, and the crop is on this account deficient next summer. In flooding waste lands, our object is, to DESTROY the coarse and useless herbage on the surface: with this view, therefore, the water, by being continued long on the surface, may serve this purpose better; for, by this means, the stems and roots of these indigenous plants may be destroyed, so as to make room for others more valuable.

Secondly, When a white scum gathers over the surface of a watered meadow, this is a signal that the water must be immediately removed: It shows that the putrid fermentation is already begun; and if the water were continued longer, it would advance, till all the meadow grasses were destroyed. In watering waste lands, there is no such necessity of removing the water when this signal begins to appear. On the contrary, when the water begins to throw up air-bubbles, and the native plants on such wastes begin to change their colour, and become black, and soft, and pulpy, these are proofs that they have already begun to decay; and hence an encouragement to continue the flood, till they be completely reduced.

Thirdly, The warmer the water is, and the richer, it must sooner be removed from meadow lands, otherwise the whole plants will be rotted, and the crop fail. In waste land, no such precaution is requisite; for the object of flooding in this case, is, not to increase the vegetation of such plants as flourish on the surface, but to destroy them. The richer the water, and the warmer the season is, this end may be sooner attained.

Fourthly, In watering meadows, it has been found dangerous to remove the water in time of severe frost. The reason of this is obvious; the water contained in the vessels of these plants, in this case, must be frozen, and expand. By this means, the fibres must be burst asunder, and these plants destroyed. In flooding waste land of every description, the water, on this account, ought to be occasionally removed in time of frost, in order that the noxious and useless herbage on the surface may, by the operation of freezing, be disorganized.

In short, the object of watering meadows, and flooding waste land, is totally different. In the former case, water is used to nourish and cherish the grasses already planted in the soil. In the latter, it is to destroy every indigenous plant, as they are generally useless. Therefore, different rules must be observed in regard to these different kinds of soil.

If these remarks be well founded, it will be no difficult matter to decide the question, at what season waste lands ought to be flooded. It is obviously idle to contend, on the one hand, that summer is the best season, or, on the other, that winter is more favourable; for it is clear that, at both seasons, the operation may be carried on with advantage; for both combine, by different means, to promote the same end.

Fifthly, *In winter*, the water is generally more muddy, at least immediately after harvest, or a sudden thaw, than in spring. The frost, too, in this season, becomes a powerful engine in our hands to rend asunder the vegetable matter on the surface, and reduce it to a soil; especially if the water be occasionally, or often removed, and let on at that season of the year.

But all these advantages combined, are not to be compared with,

Lastly, *Summer flooding* of waste land. The peculiar advantages which this season presents, are obvious.

The *heat* of the sun, combined with water, must promote the putrid fermentation of the vegetable matter on the surface of waste land. Without moisture, and a certain degree of heat, that process can neither commence, nor be completed. Hence, in warm and moist climates, no waste nor mossy land exists; although the marshes are composed of similar materials, and almost of the same plants as in colder climates. In Greece, Egypt, Demerara, and the East and West Indies, no moss or waste land appears on the surface of low-lying valleys; and if the mosses and wastes of Great Britain, were translated to the banks of the Oronooko, the Nile, or the Ganges, the former would soon be converted into rich meadows, and the latter into luxuriant pasture. If, on the contrary, the cold of winter were to continue all the year round, as in some parts of Siberia, the putrid fermentation of all vegetable matter on the surface of the earth, would be arrested and at a stand. The general heat of our summers operates, therefore, partially, in improving our mosses and waste lands, even without the aid of art.

But if we flood any waste land often, and lay it dry again during the heat of summer, we have it in our power, by this means, greatly to expedite this process; for this alternation of moisture and drought, heat and cold, must promote it with greater rapidity. Besides, the transition from heat to cold in this case, is greater in summer than in winter. When land is flooded in the latter season, the temperature of the soil is only a few degrees above the freezing point; and when the water is let off, the transition is neither very great nor rapid. Whereas, in the former, especially in the warm months of July and August, the temperature of the air at noon is sometimes above 70, while that of the soil, when flooded, seldom exceeds 50 degrees. This sudden and great rise of temperature, must tend greatly to promote the putrid fermentation of the vegetable matter on the surface, and reduce it to a soil; and by repeating this transition often at that season, by means of alternately flooding and laying the surface dry, we have it thus in our power to expedite this process.

It is well known, that a stagnant pool of water, in a warm climate, or during the heat of summer, speedily becomes putrid; whereas in winter, or a cold climate, this is not the case. The fens of Georgia, Demerara, and the north of Africa, and south of Italy, on this account, are all pestilential. An artificial lake, formed over the surface of waste land in the heat of summer, must undergo a similar change sooner or later, as the temperature of the climate is high. In all climates, therefore, this change must be sooner accomplished in summer than in winter.

The rapidity of this change, however, may be promoted by artificial means. If, in place of pure spring water, we use that of a common sewer, impregnated with alkaline and animal substances, and salts in solution, it must become putrid in a shorter period. On this account, it is more favourable for the purpose of flooding waste lands. To use the language of Mr Wimpey, "spring water may quench a man's thirst, as well as porter or strong ale: the latter, however, is more nourishing. The same is the case with water used in flooding waste land. Pure spring water may prevent the soil from being parched with drought. Foul water does the same. But it does more; it furnishes meat as well as drink to the soil."

On all these accounts, summer is more suited for the purpose of flooding *waste* land than winter. Twenty-four hours in the former season, will operate as powerfully as the same number of days in the latter. Wherever that operation is conducted, especially where putrid water is used, the coarse and useless herbage disappears, and a rapid growth of succulent grasses rises in its place. This is the case even on sterile mosses. Hence, on the banks of those pools where flax is watered, in mosses, chickweed and other plants that delight in a rich and putrid soil may be seen, though, over all the adjacent fields, nothing but heath, and coarse and useless herbage appear. These banks, too, are not only converted into a fertile soil by this means, but they may be used as a manure for other land.

SECTION VII.

Of Warping Mosses and Waste Lands.

This is only an appropriate name for a particular species of flooding. As it has been seldom or never attempted in Scotland, it may be proper to point out the manner in which it is done—the season most suitable for this purpose—the advantages that have attended the practice—and the precise situations where it may be attempted.

First, The *manner* of warping land has been described by several economical writers. The ingenious Mr Brown of Markle, who has seen it practised to a great extent in Yorkshire, describes it in his second volume on Rural Affairs, in the following manner: "We now come to another branch of irrigation, provincially called warping, which is one of the greatest improvements that can be exercised: it originated in Yorkshire, and is carried on to a great extent, especially along the banks of the Ouze, between York and the mouth of the Humber. When in that district, we had the opportunity of examining and ascertaining the different branches of that valuable operation, all of which are important, their effect being the same on a POOR soil, as upon one of the greatest natural value.

The river Ouze, is constantly stored with mud, and all sorts of alluvial matter. Being stirred, and kept in motion by the tide, that alluvial matter is, by the process of warping, conveyed over the adjoining lands, which are flat and easily flooded."

The manner in which this is done, is fully described in the West York Survey, drawn up by the same gentleman, and my friend Mr. Rennie of Phantassie. It is shortly this. "The land to be warped, must first be banked against the river; these banks are formed of earth, taken on the spot from the land. They are broader and higher, according to the impetuosity of the river, and the weight of the water at spring tides. In these banks, there are fewer or more openings to let in and out the water, according to the size of the field to be warped. In general they have only two sluices, one called the flood-gate, to admit, the other called the clough, to let off, the water gently. These are enough for 10 or 15 acres. When the spring tide begins to ebb, the flood-gate is opened to admit the water, the clough being formerly shut by the weight of water brought up the river by the flow of the spring tide. As it ebbs, the pressure of the water being taken off from without, the clough opens and lets out the water *slowly*, which had been admitted by the flood-gate. The cloughs are so constructed, as to let the water run off between the ebb of one tide, and the flow of the next. To this point, particular attention is paid: the flood-gates are placed so high, as only to let in the spring tides when opened. They are above the level of the common tides."

Secondly, The season fittest for warping, is pointed out by Mr Brown, in p. 290 of his excellent treatise. "June, July, and August," he says, "are considered to be the best months for warping, on account of their being generally the driest months. Land may be warped, however, in any season, providing the weather be dry, and the fresh water in the river very low. When the season is wet, and the river full of fresh water, this operation cannot be advantageously executed. The fresh water, in this case, mixing with the tide, makes it not half so muddy and thick, and consequently incapable of depositing the same quantity of sediment. Warping in spring, is attended with no peculiar advantage, more than in summer, as there can be no crop that year. The sediment must lie to soak and dry, before the ground can be cultivated, with the slightest prospect of advantage."

Thirdly, The benefits derived from warping, are many and great; they are described by Mr Brown in the same work. " Warp," says he, " consists of mud and salts. Letting in fresh water, would not therefore be called warping, but simply flooding. Though the latter may be useful, it is not equal to warping, as the sediment left by the latter operation, is not only more abundant in quantity, but richer in quality. In some situations, an inch of sediment is sometimes deposited over the surface by a single tide. Cherry-cob sands were reclaimed by warping; they are supposed to be at least four yards thick of warp; the fertility of such land is great. Sometimes they are ploughed and cropped 12, 14, or 16 years in succession, before they are sown down in grass. Indeed, it is proper to take at least six crops from warped land. When laid down in grass seeds, the land is not warped, for the salts and mud would destroy such a crop. Potatoes, however, have been often raised on warped land, though in its original state of inferior quality."

Land that will thus admit of cropping for 6, 12, or even 16 years in succession, must be rich indeed; and when it is considered, that this fertility is entirely owing to warping, there is no need to say more to prove the vast advantages of that process. It cannot be doubted, however, that the warp of some rivers must be much more valuable than that of others. The value must depend on a variety of circumstances; on the quantity of salt contained in the mud—on the proportion of calcareous matter washed up from the sea, or down the rivers—and on the number of common sewers from large cities, which enter into their course. Each of these ingredients must add value to the waters of any river; and the greater the proportion of all of them which any river contains, the more valuable must the warp or sediment be which is deposited by it.

Lastly, The ſituations and ſoils ſuited for warping are limited: no land, but ſuch as is on a level, or below that of ſpring tides, can be improved by this proceſs: yet of this deſcription of waſte and redeemable land, there are ſeveral hundred thouſand acres along the ſhores of the Britiſh empire. In almoſt every firth in the three kingdoms, ſuch lands may be ſeen; extenſive tracts of barren ſands, which are overflown by ſpring tides, are of this deſcription; however barren they may be when firſt redeemed from the ſea by banking, they might be reclaimed and rendered fertile by warping.

There is another kind of ſoil, of equal extent, that might be reclaimed in the ſame way. Along the Britiſh ſhores, many moſſes have been overwhelmed by the deep; they are indeed now covered with ſea ſand, ſleich and ſhells.

No veſtige of their original ſtate now remains, excepting the trunks of immense trees peeping through the ſurface of the ſand. The ſubſoil, however, is ſtill moſs, to the depth of 6, 8, or 10 feet; in many caſes, there is only one, two, or three inches of ſand on the furface. Along the coaft of Lincolnfhire, Cumberland, Weftmoreland, Lancafhire, and Cornwall, immenfe tracts of this kind of redeemable land may be feen, which might all be reclaimed by warping.

In 1810, I examined a vast extent of these lands on the West Coast of England To enter into a minute description of all the situations that may be pointed out there, would be tedious: suffice it only to take notice of Bolton sands in Lancashire. They are calculated to contain upwards of 30,000 acres; they lie, too, along the course of a river, which runs over a bed of rich marl and limestone in its course. They are not far below the level of spring tides: the surface is covered with sea sand; the subsoil is still moss. In some places, the quantity of sand deposited on this subsoil, is so small, as to render the surface so soft, that it is impassable. Men and horses, and carts and carriages, have been often swallowed up, and sunk to rise no more, in attempting to pass over it at low water. The stage coach, which runs daily over these sands, is therefore furnished with a guide on horseback; he is employed to examine the sands at every tide, and to ride before the coach, to point out a secure passage, lest they should all sink. He showed to me a spot where a horse and cart had sunk the very day before; the driver alone, with great difficulty, escaped from being swallowed up.

If this immense tract were banked in from the ocean, and if a part of the mossy subsoil were dug up and mixed with the sand, and the whole warped in the manner already described, it might soon become one of the richest, and most extensive plains of that fertile county.

The late Mr Wilkinson of Castlehead, who had already reclaimed upwards of 500 acres of absolutely barren moss in the vicinity, offered 50,000*l.* Sterling, as his share of the expense of banking these sands. But he is gone:—and probably this patriotic plan may be dropped for ages. In the Agricultural Report of that county, published in 1795, it is observed, that for 150 or 200,000*l.* about 38,000 acres might be reclaimed from the dominion of the deep in that district. Though of no value whatever in its present state, the author adds, that it might soon be worth 1,348,400*l.* Sterling.

There are other kinds of waste land that might be reclaimed by warping. Almost all the marine mosses along the British shores are of this description. As they all contain a proportion of sea salt, it is clear, that at one period, they must have been below the level of spring tide, or overflowed by the ocean; and, though they are now gorged up and swollen by the annual growth of aquatic plants, and the vast proportion of water they contain, yet many of them might, at a small expense, be reduced to a level so low, as to be warped during spring tides.

The proportion of water which enters into the composition of this kind of soil, may be ascertained by a simple experiment. A cubic foot of wet new dug moss, will weigh from 50 to 80 lib. weight, according to density or quality of different kinds of that substance. Yet, by compression alone, one-half of the weight, and in some cases much more, may be squeezed out in the form of moss water. When the moss that is left is afterwards pulverized and dried in the sun, it will lose one-third at least of its remaining weight by evaporation; so that the dry solid vegetable matter of moss, is not much above one-fourth of its weight in its original state. As moss of all sorts contains thus the greatest proportion of water, it is clear, that when drained and dug, it must collapse and sink to a greater extent than any other soil. Besides, a body of liquid pulpy moss, frequently forms the subsoil, while the surface is considerably consolidated. The Dullatur Bog, in the neighbourhood of Kilsyth, is of this description. Two or three feet of moss forms the surface; below this lies 10, 20, 30, and in some places upwards of 40 feet of liquid pulp, so loose, that a pole penetrates through it, with nearly as much ease as through a lake. If this, or any other moss of similar consistency were tapped, it must collapse and sink 10, 15, or even 20 feet. A bog in Ireland, when drained, sunk thus far.

Some marine mosses, are so loose and pulpy in the subsoil, that if drained, they might easily be reduced to a level, sufficiently low for warping; especially if the coarse and useless herbage on the surface, were, in the first instance, pared and burnt. If afterwards warped, in the manner above described, they might become the most fertile soils in the empire. Besides, it is often more easy to embank this than any other soil; for if a rim, or broad ridge, 30 or 40 feet wide, along the bank of the river, were left undug, and planted with willows, it would serve as an impervious bank, to shut out or let in the water at pleasure: While the rest of the surface was dug, and drained, and cropped, and thereby reduced to a low level, this bank, left undug, would not sink in the same proportion, but might serve the purpose at least of an excellent foundation for a more solid bank, even though, of itself, it might be too light, loose, or low, to serve that purpose.

There are mosses and moors, which, though too high to be flooded or warped, may yet be improved by mud, salt, and sea sand, thrown out by the tides. Along the Western coast of Lancashire, there are many *meres*, or salt marshes, which are only two, three, or four feet, above the level of spring tide. If parallel ditches were cut through these extensive levels, four, five, or six feet deep, so as to allow the tide freely to flow—and if by one general sluice it were prevented from receding with rapidity, so as to leave the warp in the bottom of these ditches, it might easily be thrown out on the adjacent ridges between, and operate as a powerful manure. But this is an operation different from flooding and warping. A description of it here would therefore be out of place: it will be found in Dr Rennie's Essays.

SECTION VIII.

Cautions and Directions to be observed in Flooding Waste Lands.

However obvious and great the advantages of flooding such lands may be, yet there are cases in which it may be dangerous to attempt it; and in some instances, all these advantages may be lost by injudicious cropping after that operation. On this account, the following cautions are submitted to the attention of the public.

First, Some mosses, when flooded, are apt to be gorged up to such a pitch, as to burst, and overflow the adjacent fields. Instances of this are pointed out in Dr Rennie's Second Essay. Innumerable bogs in Ireland are, on this account, unfit for flooding *in the first instance;* and all such as contain a considerable body of water, or pulpy moss, below the more solid surface, and which, on this account, rise and sink alternately in wet and dry weather, ought to be flooded with *caution;* especially if they lie, like the Solway and other mosses which I have examined, above the level of adjacent fertile lands.

To prevent the possibility of any danger of this kind, all such mosses ought to be drained and tapped for some years before they be dug or flooded. The draining will consolidate the surface; and if the bottom of all these drains be bored down to the pulpy moss below, the under water, by this tapping, will be pressed out and carried off. In a few years, the whole will collapse, and be consolidated to such a pitch, that it may be dug and flooded with safety and success.

Secondly, When mosses are flooded at first, the water should be let off with rapidity. By this means, the juices and sterile qualities of such a soil, while rendered soluble, may be washed away to a greater extent; but after alkaline solution, or rich water containing sea-sand, sleich, or salts of any kind, have been let in upon the moss, the water in these cases should be let off as slowly as possible.

Thirdly, When any mossy soil is reclaimed by flooding in the first instance, and can afterwards be flooded with ease and advantage, it should be laid down in grass after the first, or at least the second crop. By this means, it will be converted at once into a fertile meadow; and if afterwards flooded from time to time, it will still become more fertile and more consolidated. If level free, it may then be drained to such a pitch, as to be cultivated and cropped as other land, in alternate white and green crops.

Fourthly, If moss, however, lies 400 or 500 feet above the level of the sea, or upwards, it ought never to be cropped with grain; it should be sown down with *Holcus lanatus*, or planted with fiorin grass in the first instance, and ever afterwards used as a perpetual meadow or pasture, by refreshing it occasionally by flooding.

Fifthly, In the firſt attempt to reclaim moſs by flooding, the water may be admitted in the months of October, November, and December. If laid occaſionally dry in time of froſt in winter, this will be of advantage: after a thaw commences, and has reached only a few inches deep, while below the moſs is ſtill frozen, the harrow ſhould be freely applied. The froſt will ſupport the horſes' feet from ſinking, even without pattens; and one harrowing, at this time, will pulverize the ſoil more than three in ſummer. During the heat of that ſeaſon, the flood ſhould be frequently let on and off. By all theſe operations, the ſoil will be prepared for cropping againſt next ſpring.

Sixthly, All level moſs, or waſte land, ſhould firſt be dug, as well as drained, before flooding: it is true that flooding will be of ſervice, even before that operation, but it is not of equal ſervice. Undug moſs is impervious to water; of courſe, it cannot ſink deep, nor operate powerfully on ſuch a ſurface. When dug, it becomes more pervious; of courſe the water ſinks deeper, and operates more powerfully in reclaiming ſuch a ſoil.

Seventhly, Where the ſurface of any waſte lies level, and is overgrown with coarſe uſeleſs herbage and weeds, it ought to be pared and burnt in the firſt inſtance. If then dug, and after this flooded, it will produce a luxuriant crop of meadow graſſes. This is the mode followed by the Dutch, &c.; it will be deſcribed minutely in Dr Rennie's Eſſay.

Eighthly, Waſte land lying on a declivity, ought to be flooded before it be dug, eſpecially if that declivity be conſiderable: in this caſe, the ſoil, after being dug, will become ſo friable, that there is danger of its being waſhed away. After the uſeleſs coarſe herbage is deſtroyed by flooding, a ſtock of ſweet herbage will riſe up ſpontaneouſly; but to expedite this change, it would be proper to ſow the ſeeds of ſuch graſſes as are moſt ſuitable to the ſoil, and harrow them ſlightly in. In ſelecting this ſeed, attention ought to be paid to the height above the level of the ſea, as well as the quality of the ſoil.

Lastly, Warping moſs or waſte land, often is unneceſſary, at leaſt when it is reclaimed. After a ſucceſſion of crops, it ought to be laid down in graſs: warping would in that caſe be injurious to the crop. If, however, a crop of grain is afterwards attempted, it ought then to be warped, as a preparation for that purpoſe.

CONCLUSION.

After all that has been ſaid in favour of flooding the varieties of waſte land, many may regard the propoſal as fanciful. It is at all times difficult to carry home conviction, as to the propriety of any plan that is novel. The author of this Eſſay entertains no ſanguine hopes that he ſhall ſucceed in ſuch an arduous attempt: But as this plan has been adopted in the Netherlands, and many parts of the Continent, * with great ſucceſs, he is not without hopes, that ſome Proprietors, of capital, ſkill, and enterprize, may be induced to make the attempt. If that attempt were made only on a ſmall ſcale at firſt, in ſituations favourable for the purpoſe, and where it can be done at a ſmall expenſe, his hopes would riſe higher, as he feels confident that ſucceſs muſt crown all ſuch efforts: and if in a few counties the experiment were made, even on a ſmall ſcale, he has no doubt, that the plan would be adopted by many, and prove of immediate and immenſe advantage in reclaiming many of the waſtes in the United Empire.

CHAP. XI. APP. No. 5.

ON THE IMPROVEMENT OF LAND COVERED WITH MOSS, BY REMOVAL.

By Mr ROBERT KERR, Author of the Berwickshire Report.

THE improvements on moss or peat-earth, or land covered with those substances, are a new subject in Scotch agriculture. There is one mode of improvement, by which the entire stratum of moss is removed, and a remarkably rich natural soil laid bare, which is peculiar to the neighbourhood of Stirling, of which it is proposed to give some account in this place. The particulars are principally extracted from the Reports of Stirlingshire and Perthshire, in which the circumstances are detailed at large.

The vales of the rivers Forth and Teith, which join a little above the town of Stirling, and an extensive valley which stretches from below their junction for many miles, and extends along the south side of the firth or estuary of the Forth, all the way to Borrowstownness, consists chiefly of an exceedingly rich and fertile tract of deep alluvial clay or strong loam, much resembling the *warp* land on the Humber, but which is not warped. This species of soil is universally called *carse* in Scotland; and the tract in question is known by the names of the *carses* of Stirling, Bothkennar, and Falkirk. In various parts of this valley, the rich carse or alluvial clay soil is buried under a considerable thickness of moss, by which it is rendered utterly worthless; and the purpose of this paper is, to detail the means which have been devised by some ingenious men, for removing the superincumbent moss, and applying the subjacent soil to the purposes of husbandry.

* The manner in which this operation is conducted, and the vast success with which it is crowned, will be minutely detailed in Dr Rennie's Essays.

It is quite obvious, that the rich clay soil on which this flow-moss is incumbent, was formerly part of an ancient forest, by some believed to have been a portion of the Sylva Caledonia, and of which a large extent is said to have been cut down by the Roman army under Severus, to deprive our Caledonian ancestors of the shelter afforded by these fastnesses, whence they often harassed the Legions in their endeavours to enslave the country beyond the Forth. Without attempting any theory of the formation of this moss or peat soil, from the decay of aquatic vegetables in the water which had stagnated among the fallen trees fourteen hundred years ago, through the stoppage of different rivulets, it is sufficient for our present purpose to mention, that, under a depth of ten or twelve feet of worthless flow-moss, besides the remains of birch, alder, willow, and hazel, great numbers of large oaks are still found almost entire, some of which are sixty feet long in the bole or stem. The external *white* wood only of these trees is decayed, while the *heart* remains still fresh and strong, but of a black colour, probably from an impregnation of iron combined with the *tannin* from the oak and moss plants. These oaks are found lying on the clay soil under the moss, in all possible directions, as if cut down; but their roots remain entire and fixed in the earth in their original situations; and in some places five or six roots of large oaks are found in a piece of ground not exceeding twenty yards diameter. *

On discovering the value of the rich soil, overwhelmed under these waste and worthless mosses, ingenious men have at different times speculated upon the practicability of removing the gathered moss, that they might cultivate and bring to profit the rich soil on which the moss is incumbent. Several attempts have been accordingly made with this view, with more or less success. In the fertile parish of Airth, where there was a moss of 400 or 500 acres of this description on the estate of Kersie, the late Earl of Dunmore cleared about 100 acres some considerable time ago, and the present Earl is now continuing to clear the remainder with much diligence; but the means employed by his father and him for this purpose are not mentioned in the Stirlingshire Report. About twenty-six years ago, when travelling from Stirling to Bothkennar, through the carse road, we remember to have seen an extensive field of moss, then in the act of removal, by keeping up all round its borders, during the dry season, an extensive line of smouldering fire, into which the peat earth was gradually thrown by means of spades. But of this plan we have seen no account, and were not then in any degree interested in agricultural improvements. The particular object of the present article, is to give an account of a more expeditious mode of procedure for removing the moss, in which the

* Stirlingshire Rep. p. 40.

peat-earth is floated away by means of a stream of water; as detailed in the Agricultural Reports of Stirlingshire and Perthshire, which two counties meet in the rich and picturesque valley of the Forth and Teith.

No. I.—*Moss of Kippen.* *

IT is said, that Mr James Ure of Skirgarton, in the parish of Kippen, near Stirling, was the first person who conceived the idea of using a stream of water for floating off the peat-earth or moss soil into the river Forth. About the year 1730, Mr Ure first tried to carry off a small strip of his moss, by means of a rivulet, which runs into the Forth. Finding this easily practicable, he entered into contract with his neighbour, Mr Edmonstone of Broich, to carry in a stream of water upon their contiguous properties in the moss; as, on account of the interference of their lands, and the necessity of having as high a level as possible for the stream, the concurrence of that gentleman was indispensable.

The moss over all this neighbourhood consists of two distinct strata. The upper stratum, or *flow*, is composed of a light spongy mass of a whitish colour, five or six feet deep, being evidently an accumulation of *sphagnum*, *comarum palustre*, and other coarse aquatic plants, which is entirely worthless either as fuel or manure. The next stratum is composed of a black compact peat-earth, about four or five feet thick, which, when dried, forms excellent peats for fuel, or, by mixture with clay or muck, may be converted into a valuable manure for clay soils. Below this stratum, a rich clay soil is found, which is precisely of the same quality, and upon the same level with the adjacent carses. Messrs Ure and Edmonstone began their operations for clearing away the moss, by removing the upper worthless stratum, which was floated down the stream of their joint rivulet into the river Forth. For this purpose a ditch was drawn around the whole area intended to be removed, somewhat deeper than the upper spongy stratum, so that the water of the rivulet might flow in the compact stratum of black peat-earth. Every person in the neighbourhood, who had occasion to procure peats for fuel from the moss, was under the necessity of devoting several days during winter and spring in throwing the upper stratum of light spongy moss into the ditch provided for the stream of the rivulet, by which this worthless mass was floated off into the Forth. By this means a strip of ground, ten or fifteen feet broad, was annually cleared of the upper stratum around the whole area of the moss. The lower black stratum of compact peat-earth remained, from which the people of the neighbourhood dug their

* For this previous portion of the subject, see Stirlingshire Rep. p. 235—240.

fuel, spreading out their peats to dry on its surface, whence it got the name of the *spread field*. When this *spread field* had become thirty or forty yards broad, a new ditch was dug between it and the unreclaimed moss, for carrying off a new breadth of the *flow*. A second and deeper ditch was dug on the outer side of the *spread field*, completely down to the inferior clay, and to the depth of twelve or eighteen inches in that clay or carse soil. The intermediate space between these two ditches, containing the whole cleared *spread field*, was divided into parallel beds, by ditches from the higher and inner ditch to the outer and deeper one. The rivulet was let into the inner ditch, whence it filled all the lateral ditches leading to the outer one; and a number of men stationed on each side of these lateral ditches were employed to spade the moss earth into them, whence it was floated away by their streams of water into the deep outer ditch, and by which it was conveyed finally to the river. In this latter process of removing the black peat-earth by floating, a thin stratum of from nine to twelve inches was left above the clay, consisting partly of black peat-earth, and partly of the remains of wood. In the first dry season, generally in August, this was spaded into loose heaps to dry, and then burnt as a manure for the newly acquired carse soil. The roots of the original oaks of the ancient forest, which still remained in the clay, were gradually dug out and burnt, which was always a laborious and often an exceedingly tedious operation. It has been stated that the expense of clearing away an acre of flow moss and spread field from the rich subjacent carse soil, in the manner just described, was from 12*l.* to 16*l.* The process is doubtless slow; but to have removed the whole mass from top to bottom at once, would have required more than double the expense; and besides, in the moss of Kippen, where this mode was first practised, it was necessary to have regard to the future supply of fuel to the adjacent district.

The land thus cleared will yield four or even five successive good crops of oats, without any other manure than the ashes of the thin stratum left for being burnt. After this course of severe cropping, it was usual with some of the proprietors to leave the exhausted ground to gather natural herbage, after the old system of lea husbandry; and it soon became covered with *phleum pratense* and *holcus lanatus*, while the ditches were luxuriantly filled with *poa aquatica*, all of which grasses are exceedingly acceptable to cattle. This antiquated system of exhausting the soil by overcropping is very far from commendable, being ruinous and absurd in the extreme. Neither can we give much greater praise to a somewhat different system, which is said to be followed upon some part of this recovered carse soil in the parish of Kippen by one of the proprietors. He takes *three* successive crops of oats; after which he fallows the land, and gives it a copious dressing of lime, which is well incorporated with the soil, by which means it is enabled to produce abundant crops of wheat, beans, barley, &c. for several years. It has been already strongly insisted upon in the chapter on arable land, that the best mode of managing fertile soils is carefully to preserve their fertility and productive power uninjured, and not to exhaust and fertilize them alternately.

It is proper to state, that a gentleman of this district made an attempt, some years ago, to improve a considerable portion of his moss after the Ayrshire method, by draining the surface, digging it up, and laying on lime; but the experiment did not succeed. Another proprietor tried also to improve two acres after the same method, one acre on the upper *flow* stratum or higher moss, the other on the *spread field*. In both of those he had tolerable crops of potatoes; but oats and grass did not succeed. Indeed it is not surprising that attempts at surface improvement in these mosses should fail. It cannot be expected that any manure will convert much of their upper wet spongy substance into a soil fit for vegetation; and even though, by accumulating manure upon the surface, an adventitious stratum of good soil could be created, still the inert cold wet moss which lies below must have the effect of chilling the surface, and destroying vegetation. The Ayrshire method may do, and has actually proved effectual in reclaiming mosses of small depth, and having a favourable declivity. But in the deep level mosses of Airth, St Ninians, Kippen, and Kincardine, the only certain method of improvement appears to be to remove the whole mass, and to lay bare the subjacent clay.

No. II.—*Moss of Kincardine.*

THE moss of Kincardine, in the parish of that name, lies between the rivers Forth and Teith, in that part of Perthshire called *Monteith*. The lower extremity is about a mile above the confluence of these rivers, whence it extends about four miles in length, and from one to two in breadth; and, before the commencement of the operations for its removal, comprehended near 2000 Scots, or 2500 statute acres, of which about 1500 Scots acres, or 1875 English, belonged to the estate of Blair Drummond, the property of the late illustrious Lord Kames, by his marriage with Miss Drummond, the heiress of that estate.

This extensive moss lies upon a field of clay, which is a continuation of the rich extensive flats in the neighbourhood of Stirling and Falkirk, distinguished by the name of *Carses*. This carse clay, which is one uniform homogeneous mass sinking to a great depth, consists of different colours, and is disposed in layers or strata. The uppermost layer is grey; the next reddish; and the lowest, which is the most fertile, is blue. Not a pebble or stone of any kind is to be found through the whole moss; and the only extraneous bodies it contains are sea shells, of all the varieties peculiar to the eastern coast of Scotland. These are sometimes disposed in beds, and sometimes irregularly scattered at different depths. From these circumstances, it cannot be doubted that the sea has been the means of the whole accumulation, and that it was carried on by the ordinary ebb and flow of the tide; as, upon any other supposition, there could be no reason why it should not have been a congeries of all the different materials which compose the surface of the surrounding heights. From whatever cause this accumulation may have proceeded, there is no soil whatever more favourable to vegetation; or which carries more abundant crops of every kind.

Upon the retreat of the sea, the surface of the clay had been left in an almost level plain, and has been formerly every where thickly covered with trees, chiefly oak and birch, many of them of large size. These trees seem to have been the first remarkable production of the carse, and were probably propagated by dissemination from the surrounding eminences. They are found lying in all directions beside their roots, which still continue firm in the ground as they grew originally; and, from impressions still visible, they have evidently been cut by the axe or some similar instrument. For the cutting of wood, the two common purposes are, either to apply it to its proper use, or that the ground it occupies may be cultivated. In the present case, however, neither of these ends have been proposed; as the trees were left just as they were cut, and were consequently entirely lost, and the ground was rendered totally unfit for cultivation. Hence the cutting down of this wood must be ascribed to some extraordinary cause, and to none more probably than to that expedient, which, as we learn from Dion Cassius, and other historians, the Romans put so extensively in practice, to dislodge the ancient inhabitants of Britain from their forests. This hypothesis is strengthened by the discovery, in May 1768, of a large round vessel of thin brass, or mixed metal, and curious workmanship, supposed to have been a *Roman camp-kettle*, found on the estate of Ochtertyre, and presented, in 1782, to the Antiquarian Society of Edinburgh. Another kettle of the same sort, found many years afterwards, is preserved at Blair-Drummond, as also two spear-heads of the same metal, found at the bottom of the moss within these few years.

Between the clay and the moss is found a stratum nine inches thick, partly dark brown, and partly almost black. This is a vegetable mould, probably accumulated by the decay of the plants that covered the ground previous to the growth of the wood, and by the leaves of the trees thereafter. The difference in colour must be owing to a difference in the vegetable substances of which this mould is composed. The brown mould is highly fertile; while the other, especially in a dry season, is very unproductive. The growth which occupied this mould when the trees were felled, is still found entire; and consists principally of heath, among which several smaller plants are perfectly distinguishable.

Immediately above this stratum lies the moss, to the height, on an average, of seven feet, which is composed of vegetables arranged in three distinct strata. The *first* of these is three feet thick, black, compact, and heavy, and much preferable to the others for being made into peats for fuel. This consists of bent-grass, *agrostis*, which seems to have grown up luxuriantly among the trees after they were felled. The *second* stratum is also three feet thick, and is composed of various kinds of moss plants, but principally of bog moss, *sphagnum*. This stratum is of a sallow or iron colour, and is remarkably elastic. It is commonly called *white peat*, and is considered as very much inferior, for the purposes of fuel, to the former or lower stratum. The *third* stratum, which is about a foot thick, and of a black colour, is composed of heath, and a little bent-grass, but chiefly of the deciduous parts of the former.

An inquiry will here occur:—What has occasioned this succession in the vegetables of which the moss is composed? Every vegetable has a peculiar soil, more or less moist, peculiarly adapted to its nature. Let a piece of ground be in a moist state, rushes will naturally introduce themselves: Drain the ground sufficiently, the rushes will disappear, and finer vegetables will succeed. It seems reasonable to account for the succession of the different plants composing the strata of the moss on similar principles. Let us imagine an extensive plain covered with trees lying in all directions, full of branches, and possibly loaded with leaves. This would evidently produce a great stagnation of water, which would still increase as the successive crops of bent-grass accumulated; and the probability is, that at length it had so increased as to be the cause why the bent-grass and other congenial plants of the first stratum ceased to grow. After this the bog-moss established itself, which is a plant that loves even to swim in water. When the successive accumulations of bent-grass and bog-moss had arisen in process of time to six feet above the surrounding carse ground, the water that fell upon the surface had by that means an opportunity to discharge itself. It has accordingly formed many channels, which are often three feet deep; and the intermediate surface has become converted into firm dry hillocks, unfit for the growth of mosses, to which heath has succeeded.

By far the greatest part of Kincardine moss is fully seven feet deep on the average, and has in all probability lain undisturbed since its formation. This is called the *high moss*. The remainder, called the *low moss* or *spread field*, lies to a considerable breadth around the skirts of the other, and is on the average not above three feet deep, to which it has been reduced by the digging of peats. These are formed of that stratum only of the moss which lies four feet below the surface, and from that downwards to the clay, the upper stratum being improper for the purpose, and is therefore thrown aside.

Before the introduction of the plan which is now pursued, two methods chiefly were employed to gain land from the moss. 1*st*, The surrounding farmers marked off yearly a portion of the low moss next adjoining their arable land, of about fifteen feet broad. They removed the moss with carts, and spread it upon some acres of their arable land left vacant for that purpose, where it was afterwards burnt and ploughed into the soil as manure. By this means each farmer added about half a rood * of arable land yearly to his farm. But this plan did not succeed; as, by the repeated application of these peat ashes, the soil at length became so loose, that the crops generally failed. 2*dly*, Many farmers attempted to trench down the *low moss*, and to cover it furrow deep with clay dug from the bottom of the trench. This proved likewise unavailing; because in a dry season the superficial covering of clay retained so little moisture that the crop commonly failed. It has even been attempted to cover the moss with clay brought from the adjacent grounds; but, owing to the necessary impoverishment of the ground from which the clay was taken for this purpose, and the softness of the moss, this plan was soon found to be impracticable.

Draining has also been proposed as another mode of improvement; and assuredly, by means of draining, many mosses have been converted into valuable arable and meadow grounds. But, in a moss like this of Kincardine, this method would be ineffectual; as it is of such a nature, for several feet deep, that upon being laid dry and reduced to tilth, it would blow with the wind like chaff. Even when thrown aside, in the operation of digging peats, to get at the inferior stratum, it lies for years without producing a single vegetable, except a few plants of sorrel. Hence it is evident, that all attempts to *improve* this moss must ever prove abortive; and that the object to be had in view, is the acquisition of the valuable soil underneath; to which end nothing less is requisite than the total abolition of the moss by *removal*. By the methods above described, from 100 to 200 acres of moss had been removed before the introduction of the present plan, and from 1300 to 1400 acres of carse clay still remained covered with moss,—a treasure for which it must ever be interesting to dig.

The late Lord Kames entered into possession of the estate of Blair-Drummond in 1766. He had been long acquainted with

* Somewhat less than 1-7th part of a statute acre.

the moss, and had often lamented that no attempt had been made to turn it to advantage. Many different plans were now proposed for this purpose; and it was at length resolved to endeavour to sweep away the whole body of moss by means of water. The only stream at hand was employed for turning a corn mill; and being convinced of the superior importance of dedicating this stream to the purpose of floating off the moss, Lord Kames made an agreement with the tenant who rented the mill, and with the farmers who were thirled or astricted to it, who consented to pay the rent, and immediately threw down the mill, and applied its water to the purpose of clearing away the moss. In order to determine the best manner of conducting the operations, workmen were employed for a considerable time upon the *low moss*, both by day's wages and at piece work, to ascertain the expense for which a given quantity of moss could be removed. It was then agreed for at a certain rate per acre; and in this way several acres were cleared. This process was very expensive, costing frem 12*l.* to 15*l.* for each acre before it was ready for sowing; so that the acquisition of the whole, computing it at 1350 acres, would have sunk a capital of 20,000*l.* nearly. ‡

It was then attempted to let portions of the moss as it lay, for a term of years sufficient to indemnify tenants for the expenses incurred by removal. For some time both of these methods were followed; but several considerations made the latter preferable. 1. The quantity of water for the purpose was small, and was uncertain: so that it became very inconvenient for contractors, as there were no houses near the spot, and much time was lost in going and coming, sometimes to no purpose, for want of water. Such, however, as might live on the spot, would always be ready to seize every favourable opportunity. 2. The moss was an useless waste; wherefore, if let to tenants, it would increase the population on the estate, and afford a number of industrious people the means of procuring a comfortable subsistence. In the mean time, till as many tenants could be got as were able to employ the whole water, it was resolved to continue the work by means of hired labourers. Before proceeding farther, it will be proper to describe the manner in which water is applied for floating off the moss.

A stream of water sufficient to turn an ordinary corn-mill will carry off as much moss as *twenty* men can throw into it, provided they are stationed at the distance of 100 yards from each other. The first step is to make a drain or canal in the clay along the edge of the moss, sufficient to convey the water. For this purpose the carse clay below the moss is admirably adapted,

‡ Even at this rate, the land would have been cheaply purchased; as at 5*l.* rent the Scots acre, it would have now paid 33⅓ *per cent. per annum* for the outlay. At that time the value would not have exceeded 30s.

being perfectly free from stones, and, when wet, as slippery as soap; so that it is easily dug, and its lubricity greatly facilitates the progress of the water when loaded with moss. The dimensions most proper for this floating drain are found to be two feet wide by two feet deep. If smaller, it could not conveniently receive the spadefuls of moss; if larger, the water would escape, leaving the moss behind. The drain has a descent of one foot in 100 yards; and the more regularly this is preserved throughout, the less will the moss be liable to obstructions in its progress along with the water. The operator marks off a convenient extent of moss alongside of the drain, of 10 feet wide, which is the farthest distance from which he can conveniently heave his spadeful into the drain. When the entire moss is removed down to the clay from that slip of 10 feet, a new drain is dug at the foot of the bank of moss, and the operation goes on as before on a new slip of 10 feet broad. The spadefuls of moss pursue their course in the drain to the river Forth, which fortunately forms the southern boundary of the estate for several miles, without any intervening proprietor.

When the moss is entirely removed, the clay is found to be encumbered by the roots of different kinds of trees, often very large, remaining in the original place of their growth, and their trunks are often found lying beside them. All these are removed by the tenants, often with great labour. In the course of the operations, a stratum of moss six inches thick is left on the clay. In the spring, as soon as the season is favourable, this is spaded up to dry, and is burned by a smouldering flame to black ashes, which are spread over the land, and in a great measure ensures the first crop. The ground thus cleared, if the dryness admits, is turned over by the plough; and, where too soft for that implement, is dug over with a spade. By exposure for a month to the sun, wind, and frost, the clay becomes sufficiently reduced to receive the seed in March or April. Oats are invariably the first crop, and seldom fail to yield from eight to ten bolls after one. *

In the year 1767, an agreement was made with one tenant for a portion of the low moss, and the same terms have ever since been observed with all who have been procured since. The tenant holds eight Scots acres, or somewhat more than ten English, accurately 10.1664, on a lease of 38 years. For the first seven years he pays no rent. The 8th year, he pays one *mark* Scots, 13$\frac{1}{3}$d. Sterling; the 9th year two marks, and so on; increasing his rent yearly till the end of the first 19 years; paying likewise a hen yearly during the last five years: so that his rent in the

* This is rather a vague account of the produce, as the quantity of seed to the acre is not mentioned. Supposing one boll or six bushels to the Scots acre, or 4.7 bushels to an English acre, the crop in the text will be from 48 to 60 bushels the Scots acre, or from 37.7 to 47.2 bushels to the English acre.

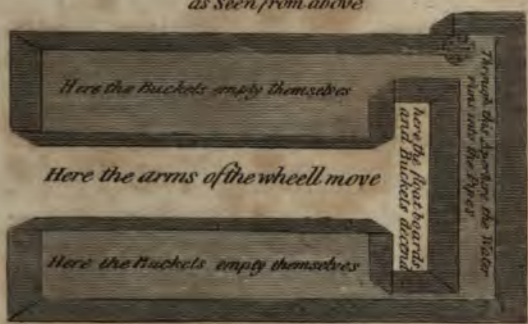
19th year is 12 marks, 13s. 4d. Sterling. At his entry, he receives a sufficient quantity of timber to enable him to construct a cottage or cabin, with two bolls, or 280 lib. of oatmeal, to support him while building his humble dwelling. Besides this, the proprietor has in the course of the second 19 years, repeated his outlay of wood, and paid the brick-tax for a second house; a tax quite inapplicable and very oppressive to these poor settlers. He also made their roads, and till lately maintained them. They have all now got a third 19 years lease, at the rate of 1*l.* 1s. an acre. During the second 19 years of his lease, he pays yearly 12s. for each acre of land cleared from moss, and 2s. 6d. for each acre not cleared, with two hens yearly. In 1768, another tenant settled on the moss; in 1769, five more were settled; in 1772, two; in 1773, three; in 1774, one; making in all 13 tenants, among whom 105 acres were disposed of, being all of the low moss to which water could then be conveyed.

In 1774, several persons offered to take possessions in the high-moss, provided that a practicable access could be made to it, being encouraged by seeing the excellent crops raised by the tenants on the low moss. In general the low moss is only three feet deep, while the high moss is from six to twelve feet deep, with very indifferent footing even for man, and utterly impracticable for horses. Without delay a road was opened, about twelve feet broad, down to the clay, for several hundred yards in length, by floating away the moss; and an opening being made to admit water, no less than 12 tenants agreed in 1775 for eight acres each of the high-moss. In consideration of the greater depth of the high moss, it was agreed that the tenants should pay no rent whatever during the first 19 years of their possession; but, during the second 19 years of the 38, to pay the same as in the low moss. From 1776 to 1782, both included, 17 additional tenants took portions in the high moss, making 29 in all; who, with the 13 already in the low moss, made 42 tenants, occupying 336 acres. For some time the disposal of the high moss went slowly on; not, indeed, for want of persons willing to take portions, but the number of operators was already sufficient for the quantity of water.

In the year 1783, Mr Drummond, the present proprietor, succeeded to the estate, and entered fully into the plan adopted by his father for reclaiming the moss. At this time there still remained about 1000 acres of the high moss undisposed of; and as water was the great desideratum, it was determined to spare no pains or expense to obtain that necessary instrument. Meanwhile, to prepare for new tenants, a second road, parallel to the former, was cut for 2670 yards across the moss, quite down to the clay, 12 feet broad. This opening was previously necessary, that the operators might get a drain formed in the clay to direct the water, and was to remain as an absolutely necessary road for

MOSS WATER WHEEL.
used at Blair Drummond

CISTERN
as Seen from above



manner in which the water is filled from the Troughs into the Buckets

the settlers. Encouraged by these preparations, the success of of the former tenants, and the prospect of a farther supply of water, 10 new tenants came forward in 1783, 18 more in 1784, and no less than 27 in 1785; making in all 55 tenants in three years, to whom 440 acres of the high moss were disposed of.

As the introduction of an additional supply of water was to be a work both of nicety and expense, it was necessary to proceed with judicious caution; and several engineers were employed to make surveys, plans, and projects of the modes in which it might be accomplished. In one point they all agreed, that the proper source of the supply was from the river Teith, a large and copious stream within a mile of the moss; but various modes were proposed for this purpose. To carry a stream by a cut or canal from the river to the moss was found impracticable, as the river was on too low a level. Mr Whitworth, an engineer of great reputation, then employed in completing the Forth and Clyde canal, gave a plan for a pumping machine, which he was of opinion would answer the purpose. Soon afterwards, Mr George Meikle, * a skilful and ingenious mill-wright, then residing in Alloa, gave in the model of a wheel for raising water to any moderate desired height, entirely of a new construction, the joint invention of his father and himself. This machine is so exceedingly simple, and acts in a manner so easy, natural, and uniform, that a common observer is apt to undervalue the merit of the invention; but, to skilful machinicians, simplicity is the greatest recommendation a machine can possess: And, accordingly, on seeing the model at work, Mr Whitworth, with the utmost candour and liberality, not only gave it the greatest praise, but declared it superior for the intended purpose to the machine proposed by himself, and recommended it to be adopted without hesitation.

This machine consists of an undershot water-wheel of large diameter, the floats of which move in a close arc of masonry, while on each rim a set of reversed buckets receive water, as the wheel revolves, from troughs placed expressly for the purpose, and deliver their water into a cistern aloft, on passing the summit. The wheel is 28 feet diameter, and has eighty buckets on each side of its rim. It makes nearly four revolutions in the minute, in which time it discharges 40 hogsheads of water. By accurate trials it was found capable of delivering 60 hogsheads in the same period; but the diameter of the pipes by which the water is conveyed from the cistern to the canal, to be afterwards mentioned, would not admit of conveying more than 40 hogsheads. The stream which moves this wheel is detached from the Teith at the place where that river approaches nearest to the

* The son of the inventor of the thrashing-mill. Both he and his father are now dead.

moss; and the surface of the moss is about 15 feet higher than that of the river. On purpose, therefore, to obtain a sufficient declivity to enable the canal to deliver the water upon the surface of the moss, the cistern into which the water is delivered by the wheel is 17 feet above the surface of the river. From the cistern the water descends in perpendicular pipes, composed of wooden barrels hooped with iron, 18 inches diameter inside, and four feet long. By a continuation of these below ground, the water is conveyed 354 yards below a public road, and across a low field, and then rises through similar pipes to its original high level, where it is discharged into an elevated open canal or aqueduct. This canal, constructed on a plan proposed by Mr Whitworth, is formed entirely of clay, raised for a long way eight or ten feet above the level of the surrounding grounds, on a mound 40 feet broad at the base, and 18 feet at the summit, the canal or water-course being 10 feet broad. From the extremity of the water pipes, to a canal formed for its reception on the surface of the moss, this aqueduct extends 1400 yards in length. The water was raised to this great height, that it might retain sufficient force or current for transporting the moss to the river Forth; both where first delivered on the moss, and after being conveyed to the most distant corners in which its agency might be required, and likewise that reservoirs might be constructed at a sufficient elevation on the moss to receive and retain the water delivered during the night. In order to make an equitable distribution of the water, that which is raised during the day is allotted to one division of the moss tenants, and that raised during the night to another division. For this latter portion, a canal has been formed for almost three miles through the centre of the moss, along the sides of which sluices are inserted in proper places to admit water to reservoirs appropriated to the different tenants, each sluice having an aperture proportioned to the number of operators to be supplied from the reservoir which it fills. No reservoirs are necessary for the water raised through the day, as it is immediately used by the division to which it belongs.

Though highly beneficial, this additional stream is not more than sufficient to keep 40 men at constant work. But a quantity sufficient to keep all the operators in constant work is not necessary; as many of them must be often employed in making and repairing their drains, grubbing up roots of trees, and other labours: So that as much water as is sufficient to give five or six hours work a day at the moss to all the inhabitants, is all that is wanted. But, as the quantity conveyed by the wheel was still insufficient for this purpose, a small rivulet which descends from the higher grounds has been brought to the moss in addition. From want of sufficient level, this stream could not be delivered on the surface of the moss; but by a drain half a mile long in one place, carried over a hollow in troughs upon piers, and by reservoirs for water conveyed during the night, it is now rendered highly useful; as, during the winter months, and after rain in summer, it is able to keep 15 persons fully employed.

In the year 1787, two more tenants agreed for eight acres each; in 1788 four; in 1789 eight; and in 1790 four. By these 18 additional tenants taking 144 acres, the whole of the high moss was disposed of, except that portion called the *flow-moss*, containing about 400 acres. Here the moss is twice the usual breadth, so fluid that a pole may be thrust down to the bottom with one hand, and the interior part, for near a mile broad, is three feet above the level of the rest of the moss. After many unsuccessful efforts, attended by much trouble and considerable expense, a stream of water has been carried fairly across the centre of this flow-moss; and a certain number of the old tenants, whose habitations were nearest, were induced to take leases of allotments of this morass. As some additional aid and inducement were here necessary, it was agreed to advance 12*l.* gradually to each tenant till he should be able to clear an acre; for which he or his successor is bound to pay 12s. yearly, or 5 *per cent.* on the sum advanced. In consequence of these arrangements 35 of the old tenants agreed in 1791 for eight acres each of the flow-moss; so that 1200 acres were then disposed of in all among 115 tenants; and as these old tenants are bound to dispose either of their old or new possessions when they have each cleared one acre of the flow-moss, purchasers will not be then wanting, and the moss will then contain 150 families upon its 1200 allotted acres, at 8 acres each.

For several years at first the water was chiefly used for forming roads and preparing reservoirs, which greatly retarded the principal object of gaining land. Yet 350 acres of excellent soil have been cleared, producing abundant crops of wheat, barley, oats, and clover; and there is good reason to believe the operations will yearly advance with increased rapidity, especially as much the greater number of tenants have only begun of late to operate. Many of these tenants, besides maintaining their families otherwise by occasional employments, have in the high moss cleared one rood of land in a year, while some have cleared two or even three roods; in the low moss an acre. Many of them now raise from 60 to 360 bushels of grain yearly, and have no occasion to go off to other work, which will soon be the case with the whole. Though few of them entered with any large stock, one only has been obliged to quit the moss from inability to proceed. Many indeed have expended their narrow stock, and even run a little in debt; but in this case they have been allowed to sell their tacks on two conditions: 1. That the purchaser was to be a responsible person; and, 2. That the seller was to take a new allotment. Some even have made a trade of selling; insomuch that, from 1774 to 1792, when this account was drawn up, no less than 52 sales had been made, producing 849*l.*, averaging about 16*l.* 6s. 6½d. for each possession.

The quantity of moss which one man is able to heave in a day, from the moss bank to the drain, whan he meets with no interruption, is seldom less than 48 cubic yards, each weighing 90 stones, or 4320 stones in all. Valuing the day's work of one man at a shilling, a cubic yard is thus moved into the drain, and consequently into the river Forth, for a farthing; while the same quantity could not be carted to the same distance for less than 6d. or 24 times the expense. An excellent gravelled road, 20 feet wide, and a mile and a half long, is now carried across the moss; and there were in 1792, when this account was written, 69 brick houses substantially built with lime. The possessions are laid off in the way best suited for the operations, and are divided by lanes in straight lines parallel to each other; and, parallel to these again, the drains are carried in straight lines, to facilitate the floating of the moss. Upon the banks of moss fronting the lanes, the operation of floating is begun, and 20 or 30 people are sometimes seen heaving moss into the same drain. That the water may be the more conveniently applied, the lanes include between them only two possessions. The new houses are erected upon each side of these lanes at the distance of 100 yards from each other. Before the lanes and roads were made, and while yet no ground was cleared, the first settlers were obliged to erect their huts on the surface of the moss. Upon the low moss there was plenty of sod or turf for this purpose, of which the walls were composed. Upon the high moss no sod was to be found; and the following expedient was resorted to. Having chosen a situation, the moss tenant dug four trenches down to the clay, so as to separate an oblong or rectangular mass of sufficient dimensions for his house. He afterwards scooped out the inside of this for a dwelling, leaving a thickness of three feet for walls, and covered the whole with an ordinary cottage roof. Upon the softest parts of the moss, where such walls could not be obtained, the houses were built of moist peats closely compressed together, and constructed on a platform of boards to prevent them from sinking. And in such situations, to stamp with the foot will shake the whole fabric and the moss for fifty yards round. These turf huts are only temporary habitations; and as soon as the tenants have cleared a little ground, they build brick houses, for which they are a second time furnished with timber *gratis* by the proprietor.

In 1792, when this account was taken, the number of Scots acres cleared was 350, or very near 444 English. The population on the moss, where none ever dwelt before, was 764, including men, women, and children, who had among them above 200 cows, and about 54 horses. By a survey in 1805, 577 acres were cleared, including 12 acres occupied by roads. At present (1814) there are considerably above 800 acres cleared, and the population amounts to upwards of 900 souls. Thus a considerable tract of ground, formerly a nuisance to the neighbourhood, has been converted into fertile land, filled with industrious inhabitants, who are all comfortable and happy! and, in a few years more, the improvements will be much extended. Besides this moss of Kincardine, there are many mosses similarly situated in the vale of the Forth, which might be reclaimed or removed by similar means, and vast extents of most valuable soil recovered to the proprietors and the community. Moss-Flanders, adjacent to Kincardine moss, is said to contain near 10,000 Scots acres, or 12,708 English, perfectly similar, but enjoying much greater advantages in respect to water properly situated for removing the moss. Mr Drummond has removed above 30 acres of a small part of Moss-Flanders, which belongs to him. There certainly are many thousand acres of mosses in Great Britain and Ireland, which might be reclaimed by means similar to those detailed in the foregoing account; by which, besides adding a vast extent of exceedingly productive soil to the stock of the community, for the growth of grain and grass, the value of individual properties might be amazingly augmented, and employment secured for a prodigious number of industrious inhabitants. It is to be observed, that, from the commencement of the operations on that moss in 1767, down to 1792, a period of 25 years, (during which time the most difficult parts of the progress of improvement were carried on), not a single individual of this moss population had applied for parochial relief.

It should be mentioned to the honour of these settlers, who have learnt by experience the value of spirited improvements, that very lately, when a new turnpike road, now nearly completed, was likely to have been stopt for want of funds, about 100 of them came forward, with a subscription of a guinea each, to carry on the work, unsolicited, directly or indirectly, from any quarter whatever.

CHAP. XI. APP. No. 6.

OF ROTATIONS ON PEAT.

By the late Mr ROBERT KERR, Author of the Berwickshire Report.

AN author, who has written on the origin, qualities, and cultivation of moss-earth, or peat, * divides this genus of soil into three species or subordinate genera, which he denominates Hill-

* Mr William Aiton, writer in Strathaven, who has already published two short treatises on this curious and interesting subject, and has announced a republication of these in a new form, with large additions.

moss, Bent-moss, and Flow-moss. In this paper, it is proposed to follow that arrangement, which is in a great measure new to agriculture, at least so far as improved husbandry is concerned. The observations to be hazarded on this topic shall be chiefly given upon the authority of Mr Aiton, who has devoted his attention in a particular manner to investigate the nature and uses of peat or moss-earth.

1. *Of Hill-moss, or Moor-soil.*

When the cultivation of hill-moss is attempted, the proper objects are to reduce the land to a proper form, to apply manure, and to adopt such a mode of cropping as that species of soil can admit of. In this kind of moss the subsoil is the chief thing to be attended to. The incrustation of moss, or black mould approaching to the nature of moss, is seldom of sufficient depth to form a soil: the subsoil therefore must be added to the moss-earth by cultivation; and the subsequent operations must be regulated by the quality and condition of that subsoil. If it be clay, it would require to be ploughed and exposed to the weather a year or two before it is cropped; if sand or gravel, as is most frequently the case, it ought to be treated like other new and poor land of that description. This subsoil being almost divested of vegetable matter, that which is on the surface, or the moss-earth, is sufficient to supply the defect; but being insoluble, it would require to be reduced by quicklime, or other stimulants, which tend to accelerate its decomposition. If the subsoil is sandy, too much exposure to the summer drought would tend to render the moss-earth still more insoluble, and could do no good to the sand. After one or two crops, it ought to be laid down with grass seeds, and pastured for three or four years. Potatoes and turnips are proper crops for such land, and these may be followed by barley or oats, with grass seeds. Green crops, by over-shadowing the ground, would bring the original moss-earth in the soil into a state of greater solubility, and accelerate its decomposition.

2. *Of Bent-moss.*

THE two other species or descriptions of moss-earth, according to the arrangement of Mr Aiton, are in a great manner absolutely new subjects in agriculture; as these have been left till very lately by all husbandmen in their original waste and unproductive state, or merely resorted to as sources of fuel, for the supply of peats in districts where coals are scarce and dear.

When it is proposed to reclaim, cultivate, and improve bent-moss, it needs no other draining besides opening proper channels for such springs as are found to rise in the moss or its edges, and to form the surface into broad ridges, raised six or eight inches in the middle, with a furrow between each, about a foot in breadth, and six or eight inches deep. These ridges and furrows ought to be formed and kept at all times as smooth and regular as possible. If inequalities abound on the surface, the heights will become too dry, and the hollows too wet to carry grain or cultivated herbage. The various fogs, or cryptogamous plants, which formerly grew on the moss, will rise on the low parts, and the heights will be turned into something like the dross or offals of a peat stack, on which nothing will grow. The ridges must be laid off in the most proper direction for the escape of water, with a moderate declivity, and the furrows laid open between all the ridges, with the plough or spade, in order to relieve the surface of the redundant moisture with which all bent-moss, and indeed the generality of uncultivated land, is overcharged. Till that is done, manure can do no good. The turf or peat-soil, cut from these furrows, and from any exuberant heights, must be laid into the low or hollow parts, to render them level.

After the surface is formed and drained, from 250 to 320 Winchester bushels of hot lime ought to be laid on each statute acre, and allowed to remain from *nine* to *fifteen* months on the sward. If the surface is tolerably regular, the moss may be laboured with the plough; but if inequalities abound, it will be better to dig it the first year with the spade, as the ridges can be thereby much better formed, and the moss dug up to a greater depth; operations, on which the success of the cultivation very much depends. Some persons plough the first year, and *delve* the next; but as the spade, in that case, cannot go deeper than the plough had done, it is best to *delve* the first year, and plough the second. The moss ought to be broken up for the first time in October or November, and in after years as soon as possible after the crop is cut, that it may get the full benefit of the winter's frost, which acts powerfully in reducing it from peat to soil. If bent-moss, after being limed, is laboured earlier than October or November, the grasses are apt to rise and injure the crop. It will be difficult to get the seed covered by the harrow in the first year; and for that reason, the hoe ought to be used in part, as it cuts and divides the soil, and consequently covers the seed better than the harrow. The roller ought to follow the hoe or harrow, as it assists to cover the seed, smooths the surface, squeezes up the moisture, and consolidates the spungy moss-earth, so as to prevent drought from penetrating, which is often injurious to the growing crop on this kind of soil. In after years the moss ought to be rolled a second time, or oftener, in May or the beginning of June.

Bent-moss ought to be cropped for three years on first breaking up; and if one of these crops could be potatoes or turnips, so much the better. It will require at least three years to reduce the best moss into proper soil; but if the cropping is continued longer, it is apt to become too dry, or what the country people call *deaf*, and does not so well support vegetation as when preserved in a moist saponaceous state. One crop of hay may be next taken; after which the moss should be pastured for two years, or at most for three. Two years in pasture rots the moss, prevents it from becoming too dry and too loose, and renders it more moist and solid. The herbage during the two or three first years is good and luxuriant; but by the fourth year, the cultivated herbage disappears, and the original moss plants rise up; or, as the country people say, the ground becomes wild. To prevent this, some fresh lime, say 130 to 160 Winchester bushels, ought to be spread on the sward in the second or third year of grass; and after remaining a year on the ground, the moss ought to be ploughed early in winter, and cropped in the ensuing spring. If oats are much wanted, two crops may be taken the second time the moss is broken up; but on no account ought more than two to be taken, as over-cropping renders the moss too dry, too light, and too open. Short rotations keep the moss moist, solid, and in a state for yielding good crops of grain, hay, and pasture grass alternately. The utmost pains must be taken to keep the moss from being poached by the feet of cattle during winter; and indeed winter pasture, at no time, and in no case, ought ever to be suffered. If the cultivated moss is too soft to carry cows during the first summer of its grass crop, either a second crop of hay should be taken, or the aftermath pastured with sheep, which is the preferable system.

3. *Of Flow-moss.*

As Mr Aiton justly observes, flow-moss does not present to the cultivator a prospect so inviting as bent-moss, though it is nevertheless capable of being reclaimed, and made to turn to good account. This is not a mere speculative opinion, or random assertion, but a well founded fact, ascertained beyond all doubt, and not in a few instances only, but by many examples, to the extent of several thousand acres in several different parts of Scotland and England. Draining of moss has always been considered as the first and indispensably necessary step in its cultivation; but the necessity and advantages to be derived from that operation have been greatly overrated. Moss is, without doubt, too soft when wet, but it is also too soft and too light when dry. It takes in too much moisture in winter, but is also often injured by drought in summer. Moss is seldom injured by moisture while the crop is growing, if the surface is rightly formed, and a vent opened for the escape of the water which falls upon the surface; though often injured or rendered useless for want of moisture. All experienced cultivators of moss have found, and now acknowledge, that over draining is not necessary, and many of them have filled up the open casts or drains which they had cut at great expense. Where a flow-moss is nearly level, and very soft and wet, a few open casts, from one to two feet deep, may be cut at 50 or 100 yards from each other, a year or two before the moss is laboured; and, when the ridges are afterwards formed, the furrows may be made to empty themselves into these casts. In all cases, drains or casts must be opened in sufficient number and size to relieve the surface from stagnant water. Where the moss is nearly level, these drains must be deeper and more numerous; but where the field to be cultivated has sufficient declivity to promote the escape of moisture from the surface, all the draining that is necessary is to form the ridges from 30 to 50 feet broad, rising eight to ten inches in the middle, with their surfaces regular, and the declivities equal, without heights or hollows, and having the furrows a foot wide, and eight or ten inches deep. To that extent draining is indispensably necessary; but all beyond that is labour lost, and would be injurious.

The generality of flow-moſs requires to be *delved* or dug over by the ſpade, for ſeveral years after it is firſt broken up. The turf-ſods, or ſpadefuls, ſhould be at leaſt ten or twelve inches deep, and ſet up regularly like well ploughed land. The deeper the moſs is cut, ſo much the better; as it ſoon melts down to half its original depth. The firſt digging ſhould be executed between the months of October and the ſubſequent March, that the adheſive quality of the moſs may be reduced by froſt before it can be formed into peat by drought; as, if once converted into peat, it will not be eaſily reduced to ſoil; but if at all affected by froſt when newly dug up, drought will not afterwards convert it into peat. As it muſt be reduced from peat to ſoil before it can be productive of grain, flow-moſs ought to remain expoſed to the weather at leaſt eighteen months or two years after being delved, before it is cropped. Bent-moſs, when limed on the ſward, would be covered with graſs in that time; but flow-moſs, when dug up, will remain almoſt without vegetation for ſeveral years. *

After being expoſed for at leaſt eighteen months, the moſs ought to be again dug over, and the turfs or clods well broken, in October or November; and being expoſed to the froſts of a ſecond winter, it may be ſown with oats in the enſuing ſpring. If much of the moſs-earth remain in adheſive clods or turfs, the hoe ſhould be uſed along with the harrow, and the roller ſhould by all means follow both; which implement ought to be again applied once, or even twice,

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* As the surface of flow-moss is generally very irregular, and covered with cushions of Bryum hypnoides, Sphagnum palustre, &c. it is recommended by some improvers as the best means of bringing it into a state capable of supporting grain, grasses, &c. at a moderate expense, to burn these cushions, along with a portion of the surface of the moss, especially where it is of great depth. Even if the ashes were of no value, yet you thus get rid of what is most difficult to be brought into a state capable of supporting useful plants; and the object in view is forwarded, by obtaining more compact peat to be converted into soil, and levelling the surface at the same time.

before the crop becomes too long for that operation. The firſt thing in the cultivation of moſs, is to reduce it from peat or turf to ſoil; and the next great object is to keep it ſmooth, and as ſolid and moiſt as poſſible. The roller anſwers theſe latter purpoſes, and cannot be too much uſed on cultivated moſſes, as their ſurface ought always to be kept exceedingly ſmooth. If the turfs or clods remain unbroken, and ſome of them are raiſed by the harrow, they ought to be carefully laid into the hollows, or low parts, that the ſurface may be made completely even. As rolling is an excellent method of rendering the ſurface ſmooth and ſolid, that operation cannot be too often repeated on cultivated moſs, either while under crop, or when in paſture. When moſs has been manured with lime, kept ſmooth on the ſurface, and frequently rolled, clover, eſpecially white or Dutch clover, will grow on it as well as on any other ſoil; but if not rolled two or three times every year while in paſture, the clover will not thrive. Moſs ground ought in all caſes to be ſown and harrowed early, while between the wet and the dry; and it ought always to be kept in view, that moſs becomes ſufficiently dry for the ſeed ſooner than any other ſoil. Drought for a ſingle day in March or April will render the moſs ready for the ſeed; and, if too dry when ſown, the crop never does well.

To complete the formation of the ſoil, a ſecond, or even a third crop may be taken, in the firſt courſe of reclaiming a flow-moſs; but on no account more than three crops before laying down to graſs. The moſs may be paſtured for two years, or at moſt for three. Some recommend laying from 180 to 240 buſhels of lime to the acre on the ſward, in the winter or ſpring before it is broken up for a ſecond courſe of crops; but others prefer ſpreading the lime on the land, as ſoon as it is laid down to graſs. It would certainly act more powerfully on the herbage, and have time to prepare nouriſhment for the ſucceeding grain crops, by diſſolving the inert vegetable matter in the peat, with which it would come gradually into contact, while ſinking into the ſoil, which it has a tendency to do. If laid on the graſs land immediately before it is ploughed over, it will be turned into the bottom of the furrow-ſlice, and may deſcend altogether beyond the reach of the plough, or of vegetation. It may be ploughed, or dug with the ſpade, if too ſoft for the plough, in November; and, if the ſeaſon is favourable, it will yield an excellent crop, or even two, of oats; after which, it ought to be laid down again to graſs. If a crop of potatoes with dung, or turnips, cabbages or carrots, is taken as the ſecond crop, either in the firſt or any after courſe, a white crop muſt follow; but never more than two crops of oats ought to be taken in one courſe, as, when longer cropped at a time, the ſoil becomes ſo looſe and dry, that it cannot ſupport any crop. What has already been ſaid of the bad effects of poaching bent moſs by the feet of cattle, applies with ſtill greater force to flow-moſs. Poaching is certainly deleterious to ſoils, by lodging water; but regular mechanical preſſure, *by rolling*, is of great ſervice to peat, under graſs or corn; and that by ſand, gravel or clay, ſpread over the ſurface of a peaty ſoil, ſtill more ſo.

4. *Miscellaneous Observations on Moss Culture.*

It may be proper to give a sketch of the observations made by Mr Aiton on the various crops which may be grown on cultivated moss.*

Wheat has been grown of excellent quality, and abundant in quantity, on the cultivated mosses of Lancashire, but does not appear to have been hitherto attempted on the reclaimed mosses of Scotland.

Oats appear to be the grain best adapted for moss culture. Mr Aiton reckons 48 bushels the acre as only a medium crop on moss, and speaks of 70 and 80 bushels an acre as no unusual crops; and even says that the best crop he ever saw grow was on cultivated moss during its second rotation.

Barley, and *bear* or *big*, grow well on moss after lime is applied; and great crops of *rye* have been produced on cultivated mosses.

Peas and *beans* are said to produce excellent crops, and to have most beneficial effects in rotting the peat, so as to render it very productive for the succeeding crops of oats.

Potatoes, cultivated in the way termed *lazy-bed*, have been long grown with much success on moss soils in Ireland and Scotland, both as to quantity and quality of produce.

Turnips, and *ruta-baga*, grow with great luxuriance on moss soils, so as to equal the best crops in the neighbouring real turnip soils. Doubts, however, are entertained concerning the practicability of consuming turnips on moss soil, or carrying them off, without vast difficulty and injury.

Carrots are considered to grow better on moss soil than on any other; and an instance is given of a crop in Lancashire weighing 84 tons the statute acre, which could have been sold at the rate of 70*l.*; some of the carrots being three feet long, and eleven inches in circumference at the thick end.

Greens, cabbages, and *cauliflowers*, grow well on moss; and Mr Aiton mentions having seen a luxuriant crop of *coleseed* on improved moss in Caithness, the property of the President of the Board of Agriculture.

With regard to the *grasses* which should be cultivated on improved moss, Mr Aiton states hose-grass, the *holcus lanatus*, as producing a valuable return both in hay and pasture. But he recommends the American Timothy grass, or *phleum pratense*, †

* Second Treatise. p. 36. *et seq.*

† Very heavy crops of this grass have been grown by the Rector of the Academy of Closeburn, in Dumfries-shire, on peat.

as superior to any grass which can be cultivated on such soils: Indeed, the crops which he mentions as having been grown of this grass on cultivated moss, are much superior to any thing known in this country on the best soils carrying clover and rye-grass. The *perennial* rye-grass, *lolium perenne*, yields a valuable return; but the *annual* rye-grass is highly improper for cultivated moss, where the grasses ought always to remain for three years. *Fox-tail* and *cat's-tail*, *alopecurus pratensis*, and *phleum nodosum*, as bearing a strong resemblance to Timothy grass, and being native grasses in Scotland, are recommended by Mr Aiton as deserving the attention of those who are engaged in the culture of mosses; as is likewise the *poa trivialis*, though it requires a very rich soil, or irrigation, to produce any considerable quantity of herbage. The white and red clovers are said to grow excellently on cultivated moss, especially when manured with lime and some clay, and when well rolled, as their roots are apt to be thrown out by the spring frosts: and by Dr Richardson and others, fiorin grass has been strongly recommended. Plantain, or rib grass (*plantago lanceolata*), and several others of our native grasses, are all said to grow well on such soils; and Mr Aiton even recommends COUCH GRASS! *triticum repens*, as deserving of being propagated on cultivated moss. Although without experience in the cultivation of moss, the vexatious consequences of that almost intolerable pest of husbandry, would cause any person to put in his earnest caveat against the introduction of that abominable weed on any cultivated soil.

CHAPTER XII.

APPENDIX, PART. 4. No. 1.

ON MANURES, OR SUBSTANCES APPLIED FOR PRESERVING OR AUGMENTING THE FERTILITY OF THE SOIL.

By JOHN NAISMITH, Esq.

THE solid parts of this globe which we inhabit, are generally overlaid with a surface of mixed matters, which we denominate the soil; by which is meant a substance capable of producing vegetables useful to man and his dependent animals. Infinite wisdom and beneficence, which accomplishes the greatest purposes by the most simple means, has destined this mean substance to fulfil the most important ends; no less than to be the original source of subsistence to all the animals of every species which reside upon it. The new born earth, when first called into existence, was commanded "to bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit." It obeyed the sovereign mandate; and thus has still continued "to supply the wants of all that live."

In the early and rude stages of society, we find that man, like his fellow animals, satisfied his wants with the spontaneous productions of the earth. But as numbers increase, the spontaneous supply becoming less and less adequate to the demand, some effort becomes necessary to make adventitious additions: and the continued increase of numbers makes new calls on industry and ingenuity. Thus those powers which Divine goodness has bestowed on man are awakened, and, by gradual improvement, become the means, not of subsistence alone, but of every comfort, and all the elegant enjoyments of life.

The first exertions of industry, to multiply the productions of the earth were, no doubt, rude and uncouth. Such hints as casual observations had given would be followed,—the soil would be partially and feebly stirred,—and such seeds committed to it as were found to yield the most abundant and most nutritive return; and this practice would be repeated till the soil was exhausted; after which new lands would be occupied, and treated in the same manner, till all that were accessible were reduced to the same condition; and at last it would become necessary to have recourse to some means of restoring decayed fertility. That such was the progression of ancient agriculture is confirmed by what has occurred nearer our own times. After the daring expedition of the immortal Columbus had added a new world to the old, the enterprising Europeans flocked to the favoured islands which he had discovered, where

> Nature
> Wanton'd as in her prime, and play'd at will
> Her virgin fancies. MILT.

On these dwelt a simple race, in the earliest stage of society,—supported solely by the spontaneous productions of an exuberant soil and climate. The bold invaders, eager to enjoy the delicate and high valued vegetable productions, which the long worn soil and feeble sun of their native lands refused to yield, exerted all that activity to which they were habituated on the cultivation of their new possessions, and obtained in profusion the recompense of their labour. Year after year the same industry was exercised till the exhausted soil could no longer make the profitable returns hitherto experienced; and it was found necessary to resort to the means practised in the old world, of making applications for recruiting it. But illustrations to show that the fertility of the soil must be exhausted by repeated culture and cropping, are needless: for, though that which is happily constructed, while it remains untouched, will continue annually to produce the quantity of herbage proportioned to its natural fertility, without failing; after the hand of industry has for some time been exercised upon it, to excite more abundant artificial products, it is at length worn out, and demands restoratives; as universal experience has fully evinced.

It is at this period, when the natural fertility of the soil has been generally diminished by repeated cropping, that a new era in the history of Agriculture commences. Heretofore, to turn the glebe,—to divide its parts,—to expose new surfaces,—and there to deposit seeds, required only corporeal exertion: but when decayed fertility is to be restored, it becomes necessary to inquire and to study what substances are adapted to the purpose:—experience must be consulted,—reasoning must be exercised,—the powers of the mind called in aid of those of the body, and agriculture then begins to assume the character of a science. As this progress advances,—so far as prejudices are overcome,—fanciful theories rejected,—the laws of nature diligently studied,—and fair reasoning from well established facts admitted, so far will this character become more perfect; and agriculture will be still more successful, as the means of supporting fertility is better understood. And this being of the first importance to the prosperity, nay, even to the existence, of society, it is surely the most meritorious employment of philosophy.

All those substances which have been administered to the soil, for awakening its latent or restoring its decayed fertility, have, by common acceptation, obtained the name of Manure, the momentous subject of this Essay. In discussing the particulars relating to which, it may be proper,

1st, To make some inquiry regarding the soil, its ingredients and circumstances, whether favourable or adverse to fertility, in order to form some judgment of the manures or substances which may with propriety be applied for its melioration, in all its different conditions;

2d, To give a general account of the various substances which have been used for the amelioration of the soil in Scotland, the effects which they are supposed to produce, and the success which has followed, according to the reports from the different districts;

3d, To arrange the substances employed as manures under the classes to which they seem naturally to belong, making inquiries respecting their different properties and effects; and in what manner any of them may be most economically managed and applied;

4th, To conclude with a few practical observations.

SECT. I.

Of the Soil in general, and of what composed; its functions, &c.

WE often call the Soil, in common language, the Earth, not without propriety, it being a mixture of some of those simple bodies which philosophers have classed under the term of the Earths. Earths and stones are defined bodies, without smell, without taste, incombustible, insoluble or sparingly soluble in water, and of specific gravity never amounting to five times the weight of water. The simple earths are always found in mixtures or combinations with one another, frequently accompanied with particles of the metals, chiefly Iron; so that we may with equal propriety call stones, petrifactions of the earths; or earth, a decomposition of stones. The simple earths discovered in the soil are Clay, Sand, Lime, and Magnesia. Lime abounds in the soil of some countries, particularly in some parts of England, in the form of chalk, but is very sparingly distributed any where in the soil, in Scotland; and in many places scarce any traces of it are discoverable. Hence husbandmen have found it advantageous to have it raised from the bowels of the earth, and carried from distant places to mix with the soil; and on that account it will more properly come under consideration in the two following Sections. Magnesia is still less frequently found near the surface than lime. It has been branded as hostile to vegetation, perhaps unjustly; but though it should be an useful ingredient, nature does not offer any obvious means of obtaining it in sufficient abundance. Clay and sand are the chief ingredients of the soil. Clay is the lightest of the earths, being only twice the weight of the same bulk of water. It takes in water slowly at first, but continues to absorb more till it becomes a soft pliant mass, intensely cohesive. It is said to hold double its weight of water, without suffering any to drop. When it is exposed to a dry air, the water quickly exhales from the surface, but is rigorously retained in the internal parts. As it hardens, it becomes full of clefts on the surface, still cohering in hard masses. Clay, indeed, is not found, in nature, in a pure state, being always mixed with a large proportion of sand, besides other extraneous substances: and it is sometimes found to contain a considerable proportion of fine sand, intimately mixed, without its cohesion being sensibly weakened, or its character differing materially from what is above stated. The weight of sand is to that of water as two and two thirds is to one. The particles of sand have no mutual cohesion, only resting on one another, and leaving interstices between them. When water comes in contact with a mass of dry sand, the former passes through the interstices of the latter, mounting upwards, and quickly pervading the whole. Sand has been found to hold about a fourth part of its weight of water without any dropping. It sometimes occurs almost unmixed, and is then very unfertile. Clay opposes great resistance to the roots of vegetables, checking and discouraging their progress. These roots pass directly through the interstices of sand; and meeting with no resistance, send forth few ramifications, and consequently form few mouths for collecting vegetable aliment.

The different proportions of these primitive earths, so opposite in their qualities, so far as they are concerned in the formation of the soil, constitute the principal difference of the various soils which occur. But there is another kind of earth which greatly contributes to the fertility of the soil in which it is contained. Animal and vegetable bodies are compound substances composed of various simples, combined, by the vital power, in an order contrary to the laws of physical affinity by which dead matter is governed. When life ceases, this combination is dissolved, and the component principles return to their original state. The earths form a part, though not a considerable part of all animal and vegetable bodies, and when deserted by their more volatile companions, are by fortuitous causes, or by manipulations, added to the soil. Perhaps, indeed, this residue is not altogether pure earth, but mixed with some undissolved charcoal, this substance being a very considerable component part of all animal and vegetable bodies; and this, its black colour would indicate. Whatever it is, its character differs from that of the primitive earths. It neither coheres violently, nor lies open and porous. It tends to weaken the cohesion of dense soils, and to fill the interstices of such as are porous. This has been, with great propriety, called vegetable mould: for, though a part has passed also through the animal process, it had first passed through the vegetable. The soils to which agriculturists give the name of Loams, are probably those in which it prevails; though they sometimes speak of hazel loams, in which, it would seem, this black-coloured substance did not abound.

There is a variety of vegetable mould, which has not all the good qualities of this here described. It occurs on elevated grounds, probably long neglected, where the Musci, and such like coarse herbage, which thrive in a degree of cold and damp, unpropitious to more valuable plants, prevail. There seems to be something in the nature of these wild plants which prevents them from rotting so completely as others; and when the undecayed fragments are mixed with the soil, they tend to increase its porosity, or they fall into a kind of earth of a more porous contexture, receiving water like a sponge, and shrinking and swelling alternately with all the vicissitudes of the weather; and, hence, disqualifying it for furnishing a proper hold to the roots of plants. But there are also other causes of this deficient construction; of which more hereafter. Where the decayed Musci have accumulated to the thickness of a few inches, this is called a Mossy soil, which is always somewhat of this deficient construction. Larger accumulations are called Moss, which covers many acres of the surface of the country, and has, of late, been the subject of much discussion.

The soil contains also metallic oxids, by which are understood metallic bodies, which being combined with that part of atmospheric air, sometimes known by the name of vital air, have lost their metallic character. Of these the oxids of iron chiefly are discoverable; and the red and the orange are both so prevalent, that there is scarce any soil which does not contain less or more of either the one or the other. When these oxids are found unmixed, the country people call the red *keel*, and the orange *ochre*; and they are distinguishable in the soil by the colour they impart. When the red oxid is prevalent, it seems to have somewhat of a binding quality, preserving the soil in a pretty compact state, little disposed to alternate shrinking and swelling; and appears to be favourable to fertility, probably on that very account; as all these red-coloured soils, under good husbandry, are found productive. The orange oxid has also a binding quality; but this is exercised on the subsoil, sand and gravel being frequently found there, bound by this oxid in solid masses; and these are injurious to the roots of plants which approach them. On the surface, it has an opposite effect, separating the particles of the soil, and rendering the whole extremely loose and porous. A sterile soil, of a very porous quality, being lately analyzed, one ounce, exclusive of stones and vegetable matter, contained

coarse-grained sand, partly fragments of white quartz, partly dark coloured, - - -	*grains.* 320	
Very fine-grained brown sand, - - -	11	
		331
Pure clay, technically called alumine, - - - -		42
Oxid of iron, - - - - - - -		107
		480

The great proportion of this oxid appears to be the cause of the excessive porosity of this soil, which prevented it from giving a due hold to the roots of plants; since, without it, the other ingredients would surely have lain compact. It is this probably which Lord Dundonald calls Earth of Iron, and notices as an ingredient in the soil. Wherever it is too prevalent, it is certainly unfavourable to fertility: for all soils much coloured with it are of a sterile quality; and where it greatly abounds, no plant will thrive. It is doubtful if its injurious effects proceed from its fine particles being conveyed with the ascending sap into the bodies of plants, or by their accumulation around the fibres of the roots blocking up the mouths by which the ascent of vegetable food is obstructed. It is likely, in part at least, owing to the latter cause: for when a plant growing in those ochrey soils is taken up, the fibrous roots appear all covered with this substance.

Spots, however, occur of a dull whitish soil, in which few traces of these oxids are discoverable, which are of a faulty construction and sterile quality: from whence it seems probable, that though the excess of the orange oxid is hostile to fertility, the absence of all the oxids would be equally, or more so. But it has been long ago suspected that those bodies, called primitive earths, might be oxids of metals; and it has been proved that some of them were so. It was reserved, however, to a celebrated philosopher of the present times,* whose penetrating genius, persevering industry, and happy discoveries, have rendered his name illustrious, more fully to elucidate this point. He, having examined some of the earths existing in the soil, has found them to be oxids of peculiar metals; and from thence concludes that all the earths found on the surface may probably be of metallic origin. Hence vital air is the agent by which the soil is formed, and is a considerable ingredient in it. Other bodies, which generally exist in an aeriform state, appear also to be combined or kept condensed in the soil; since several philosophers have extracted a large volume of air of different characters from a small bulk of these earths. Much common air likewise, forced into the interstices of cultivated land, and kept condensed there, by the pressure of the atmosphere, must lodge in a concentrated state in the soil.

* Dr Davy.

From the view here taken of the known component parts of the soil, we are naturally led to inquire, in what manner this mixture of substances promotes the production of vegetables: in the solution of which problem, we must resort a little to vegetable physiology. The seeds of plants do not freely germinate, unless they be covered from the light, and from the withering air; and a regulated warmth is required during this and the succeeding process of vegetation. For these purposes, the soil, as above described, is admirably adapted. Its particles, separated by culture, form a light and easy covering, excluding the light and drought, and admitting the rays of the sun; which it absorbs, retains, and slowly conducts, diffusing a mild heat. As the roots extend, they require a medium through which they can penetrate, and at the same time so compact as to embrace them closely around, and oppose such gentle resistance as to oblige them to ramify more copiously, and form a great number of mouths for the reception of nourishment. The different ingredients above mentioned are well adapted to this purpose. Sand tempers clay, separating its particles, and weakening their cohesion: clay fills the interstices of sand, and preserves it in some degree of compactness. Hence it is, that soils in which sand and clay are mixed in proportions considerably different, may be sometimes equally fertile. Again, the red oxid of iron binds particles which might otherwise lie too loose; and the orange oxid probably, when not in excess, may frequently tend to keep asunder particles which might lie too dense without it. Vegetable mould, when it abounds, contributes still more to that happy medium, which is the perfection of the soil. The great elasticity of air, much of which we have seen is compressed in the soil, continually actuated by alternate vicissitudes of temperature, must produce a kind of oscillatory motion, which may probably be favourable to vegetation. But growing vegetables, daily increasing in size, must obtain matter of which that increase is formed, which it does not appear they can derive from the soil as above described. The earths form only a very inconsiderable part of vegetables; and it is extremely doubtful if any be drawn from the soil in which they vegetate. The almost imperceptible mouths of the roots, by which plants receive their nourishment, seem to be very ill adapted to admit particles of gross earth; and there are instances on record, of plants growing to a great size, in boxes filled with earth, and that earth suffering only a scarcely perceptible diminution of bulk and weight. There is still less reason to think that vegetables draw the other substances of which they are principally composed from the soil, the composition of all vegetables, as modern analysis has fully ascertained, being charcoal united with two aeriform fluids, inflammable and vital air, in a triple combination. In the nomenclature now used, this charcoal is called carbon; inflammable air, hydrogen; and vital air, oxygen; and as these terms are now well known, they shall be used in what follows. Now, the carbon which colours vegetable mould, seems to be insoluble or very refractory; and we have no evidence that vegetables can detach aeriform fluids from their connexion with the soil, or decompose and modify them to their increase.

Since the soil alone, however well adapted to contribute its part to the production of vegetables, does not furnish them with food, from whence is this food derived? The atmosphere has been held to contribute considerably to the nourishment of plants; but the atmosphere is not under human controul, and comes not within our province. Water is indispensable in vegetation. Without its presence, no seed can germinate, and no plant can grow. As it is a necessary concomitant of the soil in all its functions—a principal agent both in the formation and decomposition of vegetables—and proves the nourisher or destroyer of all land plants, according to the measure and manner of its application, it merits here particular examination. Water is not, as it had long been esteemed, a simple element, but a compound of two aeriform bodies, oxygen and hydrogen, as chemical analysis has now fully demonstrated. According to Lavoisier, 85 parts of oxygen, and 15 parts of hydrogen, make 100 parts of water. To form a proper judgment of its agency in vegetation, we must view it in its different aptitudes, or laws, to which it is subjected.

1st, The first and most obvious of these, is the general law of gravitation, by which it continues in a mass, all its parts pressing towards the centre, and forming a level surface, which it still preserves, unless disturbed by foreign agents. In this state, it is affected by heat, as other bodies are, the volume enlarging as the temperature is increased; but with this peculiarity, that the volume is also enlarged by a great degree of cold, bursting the vessels in which it is confined, when it freezes.

2d, The affinity of aggregation, by which its particles adhere, and follow one another, as it were, by mutual affection. But the influence of this and the former law is slender, and is perpetually counteracted by those which follow, which are directly the inverse of the foregoing.

3d, Evaporation, by which it ascends in minute particles, and mingles with the atmosphere. This is always greater as the temperature is higher, but perhaps is never suspended, a great evaporation being sometimes observable during a clear frost.

4th, Expansion, when its particles quit their aggregate state, and are diffused through the empty pores of dry substances, a few drops moistening all around to a considerable distance. In obedience to this law, it sometimes mounts to a considerable height. When a wall of porous materials is built on a moist foundation, the marks of the damp may be seen from 2 to 3 feet above the surface.

5th, Capillary attraction, or the ascension of water in capillary tubes, in which its particles quit the mass, and rise to an indefinite height, in proportion to the smallness and nice construction of the tube. To this, the Rev. Dr Hales erroneously likens the mysterious ascension of the aqueous sap in growing vegetables.

Under the dominion of the two first of these laws, water is quite inert; and stagnant water is well known to be the bane of all land plants, and more especially of those cultivated by man. It is no less injurious to the soil, whatever be its character. By softening cohesive soils, it makes the particles more intimately coalesce, and become hard as a stone when dry, refusing admission to vegetable roots. By filling the interstices of porous soils, and its volume swelling with every change of temperature, every cavity is enlarged, more stagnant water admitted, and the defect of the soil increased; and thus the roots are chilled in rainy times, and lose their hold on the return of drought.

The three last laws are somewhat analogous in their influence, the affinity of aggregation being broken by them all. Water being then released from its inert state, becomes ambulatory, ranging through the regions of space. It is under this influence alone that water supports vegetation. In a vapoury state, it penetrates the integuments of seeds, softens, swells, and calls to life the torpid germ. It enters the minute mouths of the roots, mounts, and circulates through all the vessels of the plant, lubricating the parts, and carrying along with it the necessary aliment in solution. When the sun descends, it visits the external surface, suppling the leaves, and fitting them for their peculiar functions. Hence we see the great importance of guarding against stagnant water, and inviting its presence in an ambulatory state. For the former purpose, the water must be prevented from approaching the surface, if it comes from below; and quickly conveyed from the surface, when it comes from above. For the latter, the cohesion of the soil must be overcome, and the number of interstices increased; but the parts must lie compact, and the interstices between them of the smallest dimensions, so as the ambulatory fluid may freely circulate, and no inert water lodge.

Water, performing all these important functions, was long believed to be the sole food of plants: but a due consideration of the subject will convince us that it is not. We have seen that it is composed of two of the ingredients of vegetables, and these may be supposed to be drawn from water; but the third and most considerable is wanting. Nor is it certain that vegetables derive these two from the water which they imbibe. It does not appear that the vegetative process has the power of decomposing and assimilating water to any sensible extent, since it has been amply proved by the able experiments of Dr Hales, and others, that growing vegetables are continually exhaling, and do exhale almost all the water they imbibe. And the experiments which have been made of rearing plants on water alone, prove that though they vegetate for a time, they do not arrive at the full stature and perfection which nature has assigned them. Water appears therefore to be the agent employed to prepare and convey the food, not the food itself. But this food is provided by the same simple means observable in all the marvellous dispensations of Omnipotent Bounty. Organized beings which are, during their existence, perpetually throwing off some part of what belonged to them, finally cease to exist, and increase the exanimate mass. Putrefaction lays hold of this, and gradually converts it into food for a new race of the same beings. That this, mixed with the soil, and dissolved in water, is the genuine food of plants, is well known to the simplest cultivator of the soil, who is sensible that, unless it be lodged in the soil, by some means, in sufficient quantity, a plentiful crop cannot be expected. Affected incredulity on this point seems therefore to be the grossest absurdity.

The proper management of this substance—the means of commanding the greatest quantity—of preserving its usefulness unimpaired—of the mode, times and circumstances of applying it will be interesting topics in the following pages. But, besides the direct purpose of committing to the soil a sufficient stock of vegetable aliment, there are others which merit a large share of attention. The soil may be deficient in thickness—in its conformation; it may be possessed of vegetable aliment in a refractory state, or of substances which, from being injurious, may be rendered useful or harmless. Applications for correcting these defects are of no less importance, and must come under consideration: and as the adaptation of the soil for the reception of this aliment should precede its being applied, it may be proper to begin with such substances as have been deemed to suit the latter purposes.

SECT. II.

Of the various Substances applied for the amelioration of the Soil in Scotland, and the success which has attended these applications.

FOR the purposes of recruiting, augmenting, or exciting the fertility of the soil, the cultivators of Scotland have applied substances either derived from the inanimate mineral kingdom, or such as have gone through an organized state.

FOSSILE MANURES.

Lime, which is very generally distributed throughout Nature, is universally applied. The use of it is so antient, that there is no record or tradition of the first discovery. It has probably been handed down to us from the Romans, to whom it was known. But though it has been known from remote times as a substance adapted to awaken fertility, the use of it long continued to be partial and sparing. It is only since the middle of the last century that its beneficial effects have been generally recognized and duly appreciated. Lime is found in Scotland chiefly in the state of limestone and marble, lying either in continuous layers in the bowels of the earth, sometimes too deep to be brought up at a moderate expense, or heaped in immense blocks on the mountains. It is scarcely ever found pure, being mixed with a greater or less quantity of clay, sand, iron, &c. sometimes to the extent of 30 parts in 100. It is held in a hard mass by combination with carbonic acid and water. By the experiments of the illustrious Dr Black, 100 parts of crude lime, exclusive of all extraneous mixtures, consist of 11 parts of water of composition, 34 parts of carbonic acid, * and 55 parts of lime. It is well known that this substance is reduced to powder by calcination in a strong heat. When water is afterwards thrown upon it, heat is engendered, and it crumbles into dust. In this state it is called quick lime, and dissolves in a large proportion of water; and, with the aid of water, consumes and decomposes all animal and vegetable substances. When wetted and exposed to the air, it quickly attracts from the atmosphere its natural proportion of carbonic acid, and forms into hard masses. It is then called effete lime, is quite insoluble, and does not seem to affect dry substances.

Husbandmen have applied lime to the soil in both these states. Where nature has not furnished it at hand, it has been brought from a great distance both by sea and land, even the length of 30 miles of land carriage. † The quantities applied by different individuals, and in different districts, are various. The least, of which there is any account, is 100 Winchester bushels in powder, and the greatest 500, per acre, and different quantities between these. But it is an universal rule that cohesive soils require a greater quantity than those which are open and friable. It is sometimes spread on pasture grounds, or on clover stubble; but the most generally approved application is on ground fallowed, or such as has been ploughed for the reception of the seed, to be immediately harrowed, and mixed with the soil. Some recommend covering it in the soil before it have lost its causticity; others contend that it should lie exposed on the surface to attract fertilizing principles from the atmosphere; and others

* An aeriform body or species of gas, formed by the combination of carbon with oxygen. It exists in the atmosphere in all regions, and on the highest elevations as well as the lowest valleys, though it is one-third heavier than common air.

† Roxburghshire Report.

regard it as a matter of indifference whether it be mixed with the soil in a quick or effete state, provided it be not so much wet and clotted as not to mix intimately, which is generally admitted to be of the greatest importance. It is applied at all periods of a course of cropping; but is thought by some to have best effect when applied most recently after the land has been broken up from grass. Lime is sometimes mixed with mould, with weeds, with peat-moss, &c.; and after being incorporated with these, spread on the ground; and in this way has been found to have greater effect in promoting fertility than when used alone.

The effects attributed to the application of lime are different in different districts. It is said by some to be the foundation of all improvement: *—it strengthens and enlarges the stem;—it makes the grain more firm, more plump, and more productive of meal; † its effects on new grounds which have lain wild are reported to be astonishing, exciting a course of luxuriant crops on fields which without it would scarce have produced any. On sterile peat moss, its effects have been equally striking. ‡ Obdurate clay soils, by repeated applications of it, have been made more pliant and friable, and hence suffered less from vicissitudes of rain and drought, and yielded more certain returns, and have been more susceptible of improvement from after culture and manure. § Lime has been found favourable to the growth of peas, plentiful returns of grain having been produced on land which yielded only straw before liming. It has been found to have the same effect in promoting the growth of other of the Diadelphia tribe, such as red and white clover, hop, trefoil, &c. which never succeed on some soils till they have been well limed.‖ Rye-grass also, and all the native esculent grasses are more productive, and are eaten with more avidity on limed land. When lime has been plentifully spread on old pastures, and allowed to lie on the surface for two or more years, very large crops of grain have been produced; and the land, when moderately cropped, and returned to grass, left in a state of permanent fertility five or six times intrinsically superior to its former condition. On such grounds the crop, though luxuriant, has been observed to be later in arriving at maturity than on similar ground not limed. But repeated applications of lime have seldom been found so beneficial as the first. Hence it has been recommended to increase the dose on a second application; not to lime a second time at a shorter period than 16 or 18 years after the first; and to dung repeatedly in that interval. After all, the most prevalent testimony is, that the second liming has less fertilizing effect than the first, and the third sometimes scarcely discernible; though it is certain that husbandmen have applied lime less sparingly as the roads

* Berwickshire Report. † Linlithgowshire Report.
‡ Ayrshire Report. § Clydesdale Report. ‖ Fifeshire Report.

have been better made, the horses become more powerful, and their tackle in better order. The reports with respect to liming are, however, contradictory. While some have discovered that repeated limings are ineffectual, liming is carried on in some districts with more ardour * than ever; and the farmers of the Carse of Gowry, in particular, continue to repeat the application of lime with scarce any suspicion of its having lost its influence. While some teach that lime has its chief effect by operating on organized matter lodged in the soil, others report that it has had very little effect on land which had been long under a course of dunging and cropping. And among the many reports of the benefit of liming, some affirm that they have applied lime without any visible effect, and some that their crops have been burnt or injured by it. But, in the midst of these contrarieties, it may be safely concluded, from the concurrent testimony of the different reports, that to derive the greatest benefit from the application of lime, the land should be completely freed from the excess of water—that the lime should be intimately mixed with the other substances of which the soil is composed—that its effect is always greatest on neglected ground, when first taken under culture—that without the application of it, such ground has not been brought to the same degree of fertility by other means—that the ground thus fertilized, by too long a succession of tillage crops is greatly exhausted, becoming unproductive as well of grass as of corn, and cannot, without the utmost difficulty be restored to its former state—that lime has greater effect on cohesive than on loose and friable soils, and consequently a greater dose, or more frequent repetitions, may, with the prospect of success, be applied to the former than the latter—that on loose soils repetitions of liming are of doubtful effect, and should he used only at distant periods, and after the land has lain for some time in pasture—that lime, mixed with other substances, to separate the parts of the earthy and rot the organized, may be successfully applied on land, where alone it would have no effect: and one half of the lime used alone is sufficient for the mixture. Such are the phenomena which have been observed to attend the application of lime to the soil. Several of the gentlemen who have returned reports to the Board of Agriculture, have exhibited very ingenious theories to account for these. But as the postulata which they assume are different, their conclusions are also opposite; and need not be stated here.

Marl, though principally deemed valuable on account of the calcareous matter it contains, is described to have operations as a manure somewhat different from those of lime, and requires to be separately considered. Three sorts have been found in Scot-

* East Lothian Report.

land, and used as manure; viz. shell marl, stone or rock marl, and clay marl.

Shell marl has been found and used as manure to the soil in different districts. It was at first profusely applied, and crops of too great luxuriance were raised. At present from 30 to 40 cart loads are laid on an acre, about 16 cubic feet each load; and double that quantity is laid on strong cohesive soils. It is sometimes laid on fallow or stubble: but to spread it on grass, in summer, and allow it to lie on the surface for one or more years, is deemed preferable.

Stone marl has been found, in some instances, not to contain more than 15 per cent. of calcareous matter; in others it is richer. It has been laid on land at the rate of from 400 to 600 cart loads per acre. This heavy labour has made many farmers prefer lime, even when carried from a considerable distance.

Clay marl differs nothing from the last, except that, being soft, its parts separate with more facility, and, being sooner blended with the soil, takes quicker effect. Both these are allowed to lie some time spread on the surface.

Marble earth, found in the Isle of Skye, being a pure carbonate of lime, need not be farther noticed.

Sea-shells, beds of which have been found in many places along the shores of Scotland, are applied with success on the neighbouring grounds. They have been sometimes carried coastwise to distant places. As they are nearly pure carbonate of lime, their effect is admitted to be similar. Corals and corallines, which are also found on the coast, are considered as the same. Nor is the shelly sand, or sea sand, which has been successfully applied to ground on the coast, any thing different, except in the mixture of silicious earth, which makes it fittest for cohesive soils.

The last enumerated substances, as calcareous, must operate as lime does. Shell marl contains a large proportion of calcareous earth with some dissolved animal matter. When spread on the surface, it promotes the growth of esculent herbage—it occasions large tillage crops; and when the land is gently cropped, and returned to grass, the turf is closer, the grass more plentiful and sweeter than before. Its operation is not so quick, but more durable than that of lime. In some instances, however, it has been found immediate. It greatly promotes the growth of clover. But on cold damp soils which have been strongly marled, the crop has been found later, and the grain lighter than on limed land. * By severe cropping, marled land has been much exhausted. In Stormont and Strathmore, in Perthshire, some fields have been almost laid waste by repeated marling and over-cropping: the surface, having been rendered too loose to

* Roxburghshire Report.

hold the roots of grass, is blown about by the winds, like the dust of a dry road. †

Stone marl and clay marl contain a greater proportion of extraneous matter. Their operation is slower, but very lasting. Land, 40 years after marling, has been found to bear a closer and better cover of grass than that which had been more recently limed. Repetitions of this marl has had no good effect; nor has it succeeded well on land which had been limed before. But the application of lime has had sensible effects on land which had been marled. *

A new manure has been used by Mr Mitchell of Ayr, an account of which is given in Mr Aiton's able report of that county. Sea water is evaporated by boiling, till there be no more water left than can keep the salt in solution. With this, 32 Winchester bushels of lime shells are slacked as manure for an acre, and moistened to the consistence of soaper's waste. This is either spread singly, or made into a compost with 40 cart loads of peat moss; which last is reckoned preferable. It has been put in comparison with soaper's waste and dung, at the rate of 72 cart loads per acre; and the former rather exceeded the latter. It has since stood the test of comparison with other dressings. Both the corn crops and succeeding hay crops were good. It has been found peculiarly favourable to the growth of wheat and beans.

Gypsum has been little tried as a manure in Scotland, and according to the accounts given of the few trials which have been made, it has had little or no effect. The astonishing increase of fertility, in Germany and North America, which this substance is said to have produced, are certainly unaccountable. Yet they are strongly supported by the experiments of Mr Smith of Tunstall in Kent, communicated to the Board of Agriculture. He states that from 3 to 6 bushels of this saline compound of lime, sparingly soluble in water, spread over an acre of different species of herbage, had much more than doubled the produce, and left the soil in condition to yield a superior crop the following year. Unaccountable as this may be, there are other operations of nature for which man is equally unable to account. The well authenticated accounts of its efficacy should surely therefore induce farther experiments. Should any of these prove successful, and the proper mode of application become better known, the great abundance of it which Mr Aiton reports is to be had on the coast of Ayrshire near Balantrae, might be carried coastwise, and a great extent of country furnished with it, at a moderate rate.

Soaper's Waste is used as a manure in the neighbourhood of

† Perthshire Report.

* Berwickshire Report.

places where soap is manufactured. It is said to require as much bulk as of dung to produce a good effect, and then it is a good and lasting manure, producing good crops of corn and grass. It is most effectual when spread on grass grounds. But its weight and bulk make lime preferred when the distance is considerable.

The following substances, though not calcareous, are used as manure, and originate from the mineral kingdom.

Refuse of salt, procured from salt manufactories, is said to answer as a manure. But no account is given of the circumstances relating to its application.

Ashes of coals, wood, and peats, consumed for domestic use, are carried out everywhere, and applied as manure. They are brought also from towns, and from manufactories where much fuel is consumed, and are found to have an immediate effect in exciting fertility. But ashes, made in families, are more frequently laid in heaps, mixed with other offals; and chamber lie, soap suds, and dirty water, thrown upon it. They are then found to be a powerful manure; peat moss is sometimes burnt for the purpose of making ashes to be spread on grass ground, and soon produces a superior verdure. The most approved way is to burn it in kilns or smothered heaps. The moss which is become rotten and brittle, bearing coarse herbage, is most easily burnt, and yields the most ashes. Ashes are found to be rather a quick than a lasting manure.

Burnt clay or earth is found to occasion an increased fertility wherever it is applied. But paring and burning, the means by which it is most plentifully obtained, is now almost abandoned in Scotland, except in some few places where there is a considerable bulk of soft mossy matter on the surface. In those districts where paring and burning was practised, it is reported that very luxuriant crops were first obtained; but in the end, it was found that the soil was left almost in a ruinous state, and could scarcely be restored to its original fertility. Hence the practice has been much reprobated; and agriculturists have not yet resorted to any other means of obtaining burnt earth to any extent, though it is acknowledged to be a valuable mixture in the soil.

Soot, chiefly from coal fires, is collected in towns, and carried to farms in the country, sometimes to a considerable distance. It is used as a top-dressing in the spring for young wheat or artificial grass, and sown from the hand. It has thus been found to forward vegetation. That which is recently made is preferable to what has been long kept.

Clay and sand are sometimes applied as alteratives, each to correct the faults of a soil which possesses the opposite quality in excess. It is a laborious operation, but is found to have happy effects. When the parts of clayey soils are separated by mechanic labour, in a dry ſeaſon, ſand is eaſily mixed with them; but clay does not mix with ſandy ſoils with ſuch facility. This ſucceeds beſt when the clay is ſpread on the ſurface, and lies till froſt and rain have ſeparated its particles. It then gradually mixes, in the courſe of ploughing.

Irrigation, the fertilizing of land by the means of water, muſt be conſidered as a ſpecies of manuring obtained from the mineral kingdom, ſince it is admitted that irrigation fertilizes chiefly by the matter which the water brings along with it from the ſurface, or from the bowels of the earth. In ſome diſtricts, the floating of arable land, while in graſs, to enrich it for a courſe of corn crops, was much practiſed. Dams were made to divert the courſe of ſtreams, aqueducts built to conduct the water over hollows, and trenches cut to take it through heights; and thus a conſiderable extent of ſurface was frequently overflowed. The large crops which were thus obtained awakened the avidity of farmers, who continued alternately to float and crop till the ſoil was ſo much exhauſted that it could neither carry corn nor graſs. The practice is therefore diſcontinued. Careful huſbandmen beſtow ſome pains to lead the water from the higher grounds, or from brooks which have a higher ſource, over the flat marſhy meadows, which are kept in perpetual graſs. Theſe were thought valuable poſſeſſions, when the culture of artificial graſs was leſs common; but many of them have been drained of late and ploughed for corn crops. Some individuals, induced by the ſucceſsful irrigation of meadows in ſome Engliſh counties, have begun to follow the example. Though perhaps the ſame perfection in that art is not yet attained, nor the increaſe of graſs ſo conſiderable, yet evident improvement has been made on meadows in different parts of the country, which will probably induce others, whoſe ſituations are adapted to the purpoſe, to follow the example.

DECAYED ORGANIZED BODIES.

Farm dung, it is admitted on all hands, of all the ſubſtances applied to the ſoil, is that on which the preſervation and advancement of the general fertility of the country principally depends. Moſt of the gentlemen who have ſent reports to the Board, reprobate, in ſtrong terms, the negligence and inattention of farmers in the collection and management of this important ſubſtance, and with great juſtice; for though the fault is not univerſal, it is but too general. It is aſtoniſhing to ſee a man, ſhrewd and ſagacious, toil himſelf or ſervants and horſes through ſtorm and mire, labouring land for a crop which he knows he has already exhauſted; or going twenty miles to a market in hope of getting a ſhilling more for a horſe or cow than he could get at home; yet walking about his doors to his ancles in muck, and ſeeing it gliding off in ſolution and filling every gutter, or waſhed away in torrents by every ſhower, without taking his ſhovel in his hand, or bending his back to collect and preſerve it. Should we call this diſregard to his intereſt, or ſhould we call it lazineſs? His keen avidity, and his ardent activity in other caſes will riſe in evidence againſt us. To what then are we to attribute this ſhocking neglect? Tell him, that by every little clot which is diſſipated, he loſes a handful of corn, he will aſſent, and will add, that he has not time to attend minutely to that article. But there are few things on which a farmer's time could be more profitably employed: and the moſt aſſiduous ſpend much time to leſs purpoſe. The general idea of the deſpicableneſs of the ſubject has probably prevented method and attention from being applied to it. The obvious intereſt which every farmer has in making the moſt of his dung, it may be hoped, will ſoon overcome this bad habit; and thus the general fertility of the country will be ſenſibly increaſed.

In the beſt cultivated diſtricts, the farm-yard, where cattle are foddered, is cleaned once in three or four weeks; and its contents mixed with the dung and urine from ſtables and cow-houſes, which are daily cleaned; to which are added the caſt thatch of thatched houſes and all other putreſcible offals, the ſcrapings of paſſages, aſhes and waſte water from the dwelling-houſe. This heap ſometimes lies untouched till it be applied to the land, ſometimes is turned in the place where it lies, ſometimes carried out, and laid in a heap in a corner of the field where it is meant to be applied, turned repeatedly and watered when too dry, till it be completely rotten. Thoſe who dread the effects of the condenſation of dung by the trampling of cattle in the ſtraw-yard, remove it frequently to a place where no cattle have acceſs, turn the heap and water it as before, till completely rotten. * Thoſe cultivators never uſe recent dung: for turnips, eſpecially, it muſt have undergone the laſt ſtage of putrefaction, and become crumbling: for wheat, it muſt be nearly in the ſame ſtate; and when it is not in this ſtate of preparation, it is allowed to lie and rot over year. Yet theſe people who turn their dung heaps frequently, think expoſure to the ſun and air highly injurious to dung. Some however uſe the dung before it be entirely rotten, while it is clammy and adheſive, and the organization of the ſtraw litter is not deſtroyed. † The dung which is carried to the field is ſometimes mixed and covered with mould, with a view perhaps both to facilitate the rotting, and to add to the bulk. Others again make an excavation for the reception of the dung, either in a denſe ſoil through which no juice can percolate, or artificially ſecured againſt that waſte, and ſurrounded with a wall to retain moiſture. ‡ Here a thick layer of peat moſs or other putreſcible matter is recommended to be laid in the bottom, over which the

* East Lothian Report. † Berwickshire Report. ‡ Fifeshire Report.

dung is regularly laid. In ſome diſtricts, the laſt or putrid ſtage of fermentation is barely allowed to commence: the dung is always kept moiſt and moderately compact, and laid on the land before it be much rotted. Some even give long dung the preference of that which is ſhort and rotten, eſpecially for wheat and potatoes, provided it has been kept moiſt and immediately ploughed into the ſoil. Dung made by high fed cattle is much preferable to that of thoſe which are lean and ſparingly fed.

Town dung is brought from towns and populous villages to which little land is attached. It conſiſts of the excrements and litter of domeſtic animals, aſhes and every kind of garbage, ſweepings of houſes and ſtreets, ſoaked generally in putrid liquids. This is greatly in demand. Farmers ſend hay, potatoes, turnips, &c. to towns, and bring back dung. It is ſold at various prices in different diſtricts, from 2s. 6d. to 6s. per ton. It has been obſerved that farmers who have acceſs to town dung, are leſs attentive to making it at home. From great towns it is ſometimes carried eight miles and upwards, and becomes a coſtly manure.

Dung of birds.—There is no particular report about it. But it is known to be a very powerful manure where it is to be had.

Woollen rags are used as manure. Formerly poor old people went round and collected them in magazines, from whence farmers were accommodated. As 70 or 80 stones, hay weight, were reckoned sufficient dressing for an acre, they were sometimes carried to a considerable distance, cut in small pieces, strewed over the field from the hand, and ploughed in. Whether it is that the expectations of those who used rags have been often disappointed, or that new channels of employment have carried off the collectors, this kind of manuring has fallen much into disuse, and rags are now more frequently thrown promiscuously into the dunghill, and carried with other matters to the field. They are still however partially used, and reported to have a good effect, especially on the potatoe crop. Animal hair, which is nearly of the same nature with wool, sells too high to be used as manure.

Sea weed, or sea-ware, is used as manure all around the coast. Of this genus of plants, there are four species found on the coasts of Scotland, which are applied to that purpose. Fucus vesiculosus, F. nodosus, F. serratus, and F. digitatus. Towards the heads of the narrow bays, and the upper parts of the embouchures of rivers, the F. serratus is the most common, and is said to have the weakest effect. It is recommended to spread these weeds fresh from the shore, and immediately plough them in; as their chief value consists in a very soluble gluten, with which they are replete when they come fresh from the sea. If that is not convenient, they should be formed in heaps, and well covered with mould. When peat moss is at hand, it is a proper subject for this mixing; as the weeds quickly excite a fermentation in it. The weeds are sometimes laid in the dung-stead, and immediately covered with a thick layer of straw-yard dung. But it is also reported, that they have a good effect when spread on grass-ground, and allowed to lie on the surface, the herbage of the field receiving and absorbing the gluten of the weed. It has a better effect on friable than on cohesive soils, and should be ploughed in with an ebb furrow, to keep it near the surface. The effect does not last more than two years. Pond and river weeds seldom occur in abundance; where they do, they are sometimes mixed with other substances, and used as manure.

Folding or teathing, is a mode of manuring, by which the excrements of domestic animals are applied at once to the soil. In the early stages of rural improvement, this was the only mode by which manure was conveyed to the out-fields. But as improvement advanced, the husbandman became more solicitous to have the manure at command, to be applied at his own discretion: cattle were more confined to houses and sheds, and not suffered to lie without doors, except those which fed on enclosed pasture. But folding is still practised in some districts. Walls of sods are made to surround a fold, or range of folds, containing as much ground as it is deemed the stock to be confined in it might manure. Moveable flakes, formed of slender spars of wood, are now frequently used instead of sod walls, and are easily shifted from spot to spot, as each gets enough of manure. Where small flocks of sheep are kept, which have not far to travel for their pasture, they are sometimes confined in the same manner. The usual time of folding is 16 weeks, when the stock rest in the fold during the night, and two hours in the middle of the day, about the summer solstice, and a month thereafter. During the time of folding, 10 cattle, or 30 sheep, are allowed to manure an acre; and land, thus manured, is found to yield two or three plentiful crops. It has been objected to this practice, that the cattle are injured by being too long confined in the morning, and the folding being too long continued for the sake of the dunging. Some have also suffered loss, in the ensuing corn crop, from the great number of slugs, bred from the eggs which the dung lying on the surface in summer, had induced the parents to deposit, especially on clayey soils. Others think it a very economical practice in certain situations. Sheep are fed on turnips in winter, enclosed in similar flakes, or in nets of whipcord suspended on stakes. This has proved very beneficial on dry porous soils, which are enriched with the excrements of the sheep, and consolidated by the trampling of their feet; but is not so suitable on soils in any degree cohesive or retentive of water. The soil, by winter poaching, is disqualified for the ensuing crop, and the animals have a comfortless lodging.

Decayed organized bodies, and the exuviæ which they have thrown off, amassed, form the complex substance which we denominate Dung; which, after being subjected to less or more putrefaction, is administered to the soil in various quantities, and in different circumstances. For turnips, after the ground has been properly reduced and cleaned, it is commonly strewed in furrows over which the plants are to grow, covered immediately with the mould which had been thrown out, and the seeds sown over it; or sometimes it is spread over the whole surface, and ploughed in. Where the soil is of a favourable contexture, and has been long under good culture, and regular manuring, from 15 to 20 cubic yards is allowed for an acre; but to soils in worse habit, from 30 to 35 have been sometimes given. On fallow lands, prepared for wheat, a fourth or a fifth part more is frequently allowed than for turnips. Clover ley is also sometimes dunged for wheat, with a greater or less quantity, as the state of the land is deemed to require; and sometimes land intended for a bean or pea crop, is dunged with a view to a succeeding wheat or other crop. Land prepared for potatoes, is almost always dunged; and in some districts to a great extent, not only for the sake of the potatoe crop, but for those which are to follow. Formerly, barley or bear was the crop to which the greatest part of the dung was administered; but of late, the land being previously put in good condition, it is commonly sown without dung. It continues to be a practice in some districts to lay dung on pasture ground as a preparation for tillage crops. This is done either before winter, or early in spring, before ploughing. This is thought by many not an economical practice. But those with whom it has succeeded, find it sometimes convenient, and it is not discontinued. There is little dung spread on the surface to recruit the grass. and keep the land in meadow, in Scotland; hay from artificial grass being much more in request than that from natural meadows.

There is no difference of opinion respecting the efficacy of dung to promote fertility, or of the mode of operation. It is universally admitted, that the principles of organized bodies, having suffered decomposition, again become the parts of new organized beings. This bountiful dispensation of Infinite Wisdom is visible to the most heedless. We cannot miss observing that, as the substances of which dung is composed, putrefy, some part is continually dissolving in water; and that this solution, wherever it comes, promotes a vigorous vegetation; and we naturally conclude, that when this substance is mixed into the soil, it must be dissolving in every shower which falls, and be carried up into the organs of growing plants; and this we plainly see continues till all that is soluble is consumed; and then a new recruit is required. Hence the concurring testimony from all qu irters is, that dung is the most valuable of all manures;—that the productions of every farm chiefly depend on the quantity which can be collected, the care with which it is managed, and the judgment with which it is applied;—that lime or other substances may fail of efficacy on repetitions, or evince none on some soils; but dung increases fertility on all soils, and on all occasions. Whatever difference of opinion exists about the preparation, it is generally admitted that it should be regularly spread, and its parts fully disunited and separated; *—that moderate dungings, frequently repeated, are greatly preferable to large doses, applied at more distant periods. Thus it appears, that organized bodies, putrefied, are the only direct food which human industry can administer to growing vegetables; and therefore the careful collection, and judicious husbanding of them, is an important branch of the art of Agriculture.

Town dung differs from that made on farms, only in containing a large proportion of the spoils of animals and of ashes or earthy substances. Its operation has been found quicker and more powerful, but not so lasting. Farmers who have used both on conterminous lands, observe, that there is always a more luxuriant vegetation, the first year, where the former was laid, but little or no difference in the succeeding crops. For this reason, it is not uncommon to lay the farm dung on land for wheat which is sown in autumn, and town dung for spring crops. Hence it is evident, a difference exists between animal and vegetable substances in their operation as manures; the former, being most soluble, seems to furnish the most immediate subsistence to growing plants.

But the prevailing practice in making manure, is to mix both animal and vegetable substances together. It is judged improper to keep them separate, and besides would be attended with inconvenience. We have therefore no decided opinion of their comparative character and value. Hence nothing can be said of spoiled flesh, fish, and oil, animal substances; or of malt dust, rape and lintseed cake, vegetable ones, not included in the above enumeration. Like other putrescible bodies, they may no doubt be used to promote vegetation, when they can be had on such terms as to be profitably applied to that purpose. But seldom

* It has of late become a prevailing opinion, that dung should be deep-buried in the soil at first, and that it will be raised higher by after ploughings;—that, by deep covering, the dung is defended from the injurious effect of exhalation, and the roots of plants soon find their way to it. But there are people of accurate observation, who, from long experience, have found, that if dung is only covered, the nearer the surface it lies, its effects in promoting fertility are the greater. And they assert that this ought to be so: for then it lies near the roots of young plants, at the time when they need the most cherishing nourishment. Those people also declare, that they never saw dung, after it had lain mixed with the soil for a season, rise to the surface. On the contrary, they observe, that as it dissolves in the earth, the solution descends as low as the soil has been stirred by the plough.

any of them are so abundant as to make a conspicuous figure, and there is no report relating to the application of them as manure.

Horns and hoofs of animals, however, are a substance of a peculiar conformation. This has been used as manure, and esteemed a valuable one. Shavings of horn from places where that article is manufactured at home, and quantities imported from Ireland, are spread on the land at the rate of about 60 stones per acre. They are strewed on the ground by hand either on grass or fallow, and have been found to occasion a considerable increase of fertility. The effect is most evident where the soil is not of the poorest quality, and has been distinguishable for several years. It has been remarked that where this substance is applied, no moles burrow.

The bones and skins of animals, differ also in their conformation from most other animal substances. The former is recommended by the celebrated Mr Kirwan as an appropriate manure for wheat, but scarcely used in Scotland. It is believed that after the oil and mucilage they contain are exhausted, they can be of little use, as the combination of the principles of which they are chiefly formed, resists decomposition for a very long period. The latter is also a compound not soon decomposed. Pieces of useless skins, and parings of tanned leather, are sometimes laid on land, with what effect there is no report: but as they may be seen remaining in the ground a long time after, it is probably neither great nor sudden.

Scarce any of the substances above enumerated and described are homogeneous bodies; and the substance denominated Dung is the most complicated of all. Yet husbandmen have been in the constant practice of mixing several of them with one another, before applying them to the soil. These mixtures are called Compost, and consist of various ingredients.

The first kind of composts of which there are any accounts, was soil covered with a close sward of herbage, found by the sides of roads, brooks, or waste corners, which had lain long neglected, (often called virgin earth), mixed with lime and fresh farm dung. A base of the earth was first formed, over which a coat of dung was laid; a layer of earth succeeded; then lime either in shells or powder, which was again covered with earth; and so on alternately, a layer of earth always intervening between each of the other substances, till the heap was raised to the height of 4 or 5 feet, the top being covered with earth. This was afterwards cut in pieces with spades, turned and mixed, and perhaps turned again and again, till it was thought fit to be carried out and spread on the ground. Either lime or dung was sometimes used without the other. The swarded borders of peat mosses are sometimes used in place of mould. A more compendious mode of making compost has been also practised. Old headlands, where much mould had been accumulated, were ploughed, and lime in shells was laid over the stirred earth, and the loosened mould was shovelled in from the sides till the lime was covered, and a kind of long heap formed. This was afterwards turned with the plough, and prepared to be spread on the field. Sometimes lime and mould are first mixed and incorporated, and dung afterwards added, and mixed with the whole. Marl is sometimes substituted for lime in composts, mixed with mould or peat moss. Sea-weed is made in composts, where it ferments quickly and facilitates the putrefaction of other putrescible bodies. All kinds of weeds, the grass and mud scoured out of ponds and ditches, are frequent ingredients in composts. There are descriptions of the compost made in different districts. But as the substance of them is comprehended in the above, more minute detail will be needless. They generally agree in judiciously recommending that the mould of the compost should differ in consistency as much as possible from that of the soil to which it is to be applied. The Right Hon. the Earl of Dundonald, who has devoted his penetrating genius to the benefit of the public on various occasions, recommends a compost of lime and peat moss, which has been used with success. One part of lime slacked to a mild powder is mixed with five parts of peat moss and turned till both be incoporated. This succeeds best when the moss has been turned out some time, and exposed to the action of the weather before mixing: but the moss must not be dry when mixed. The learned and profound Lord Meadowbank, by his example and instructions, has favoured the public with a very important purpose of peat moss compounded. But rules for the preparation being already in the possession of the public, the practice of preparing and applying become pretty extensive, and the good effects experienced, it is unnecessary to dwell on the subject.

More than double the bulk of earthy composts to that which is usual of plain dung, is thought requisite for manuring a field. They are applied with much greater propriety to grass grounds and all kinds of surface dressing than dung; and have also been applied with advantage on fallow, especially on all kinds of thin soil.

Broad-leaved plants, raised on the ground and ploughed into it, may here be stated as a kind of compost, of which the soil and the crop are the ingredients. This has not been much practised in Scotland, and there is no particular report concerning it. The most common opinion is, that it would be more economical to consume the crop with live stock, and carry their dung to the field.

Sea-ooze or sea-sleech is a spontaneous compost, of an excellent quality. It is an accumulation of dissolved animal and vegetable spoils enwrapped in particles of clay which have been precipitated from the agitated waters when they arrive at a quiet bed in any land-locked creek. With these the powder of triturated shells and grains of fine sand are blended. This gives a durable improvement wherever it is applied.

The preparation of earthy composts is found to be a very operose employment; but the benefits attributed to the application of them to the soil are very important. They communicate a durable amelioration to thin and sterile soils—correct the faults of those which are of defective construction—and occasion a closer and sweeter turf, and more frequent reproduction, when the land is laid to grass. When lime only is mixed with mould, half of the lime which would be used alone is sufficient; and the compost promotes an increased fertility where the full quantity by itself would have no effect. The compost of peat-moss is still more beneficial, as it augments the quantity of manure fourfold or more of equal quality. Moss, being a vegetable substance, after undergoing fermentation, becomes capable of being dissolved slowly, and going to the food of growing plants. In the mean time it mends the consistence of dense soils by separating their particles, and aids dry porous soils in retaining moisture, till it be dissolved.

The economy of Scotch husbandry, by which a regular alternation of white and green crops, of corn or other tillage crops, and grass or pasture ones, is observed, acquires to the soil a stock of spontaneous manure in addition to what is administered by human industry. It is evident to every observing eye, that all growing plants attract a part of their subsistence from the atmosphere, by means of their leaves; and hence those which have the broadest space of leaves must derive the greatest proportion of their accretion from that source. When broad-leaved plants are cultivated, as the growth proceeds, new leaves are still forming; and the earlier, giving way to the later, fall down and rot on the surface. Thus some share of manure is acquired, even while industry is exerted to draw the greatest possible product from the soil. But when land is again left at rest in grass, not only the benefit of folding is partially derived from the excrements of the animals which feed upon it, but the lower leaves of grass which, though narrow are numerous, still drawing part of their aliment from the atmosphere, escaping the mouths of pasturing animals, fall down and enrich the surface with their spoils. When other plants cease to vegetate, the Musci, to which nature has denied a rostel to penetrate the soil, and draw their sustenance thence, raise their heads, and batten on the atmospheric banquet, which no competitor appears to dispute. These acquisitions of a few years, the returning plough mixes with the soil; and an augmentation of fertility is obtained; which is altogether lost where land is kept in perpetual grass.

These are the various means employed by the agriculturists of

Scotland to preserve or increase the fertility of the country, in which great advancement has been made, in the course of the last thirty years, and the annual product of the country considerably increased.

SECT. III.

Of the Classes to which the various Substances employed as Manures properly belong, their Properties and Effects.

THOUGH all those who have treated of agricultural subjects have attempted to arrange manures under different classes, it is a matter in which some difficulty seems always to have been found. Some have classed them according to the manner they are supposed to operate; others according to the origin from whence they are derived. According to the first mode, it has been very common to arrange all substances regarded as manures under two classes, viz. *nourishing* and *stimulating*. This arrangement seems to be very imperfect; for though we may form a pretty distinct notion of any substance which nature has adapted to the purpose of increasing the size of another, by being gradually added to it, and if the latter be possessed of animal or vegetable life, we may with propriety say it is nourished by the former; yet not being instructed whether it is the soil which is stimulated, or the plants which grow upon it, and unable to discover how this hidden operation can be conducted, we must find stimulation a mystery beyond the grasp of ordinary understandings. To arrange manures under the classes of *natural* and *artificial*, is not less vague and unsatisfactory, not coming under either of the above general modes of classification. The ingenious Dr Dickson, in his work on Scotch Husbandry,* classes manures as follows.

1st, Such as communicate to the soil the vegetable pabulum which they contain.

2d, Such as enable it to attract vegetable food from the atmosphere.

3d, Such as give a more unlimited range to the roots of plants in quest of food.

4th, Such as prepare the food lodged in the soil for entering the roots of plants.

This is a more specific classification of manures, respecting the manner they are supposed to operate. But since the fanciful doctrine of salts and oils being attracted from the atmosphere has been exploded, it is doubtful if the atmosphere contains any matter which substances used as manures attract and communicate in support of vegetation. The second class may therefore be omitted; and, reversing the order, the classification, according to this view, might be as follows.

* Page 358, *et seq.*

1st, Substances which correct the defects of the soil, and adapt it for its various functions in the production of vegetables.

2d, Such as facilitate the decomposition of vegetable food lodged in the soil.

3d, Such as directly furnish food to growing plants. †

But the author above mentioned justly observes, that substances used as manures may be adapted to more than one of the above purposes, and, of course, cannot, with strict propriety, be arranged under any of the above classes. To avoid this dilemma, we are obliged to resort to the other mode of classification, and arrange all manures according to the origin from whence they are derived. And having placed all the substances, known to have any effect as manures under the particular classes to which they naturally seem to belong, by examining each in their order, inquiring into their respective properties, and the different effects they ought to produce, so far as science or experience has instructed, the husbandman may be enabled to judge how to apply any of them, in all circumstances, with the greatest propriety, and with the surest prospect of success. The classification will thus be the following.

1st, Fossil manures; that is, substances taken from the earth, or having the character of Earths, as defined in Sect. I.

2d, Animal; the exuviæ and remains of animal bodies.

3d, Vegetable; all vegetable substances, after vegetable life has ceased.

4th, Composite; by which is meant the mixtures of the three former, which husbandmen commonly use as manures.

Under the three first will be specified, all substances which have been used as manures, either separately or mixed, making some inquiries concerning the qualities of each; but as these substances, particularly those of the second and third class, are seldom applied in a separate state, these mixtures, in their different proportions, and the manner in which they are managed, must be considered at some length under the last class.

FOSSIL MANURES.

Fossil manures are of three kinds; 1st, Calcareous; 2d, Non-calcareous; 3d, Mixed.

1st. *Calcareous.*—The calcareous manures are limestone and marble, burnt and reduced to powder; marble earth, sea-shells; Shell marl, soaper's waste, and Mitchell's manure, till better

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† The heads under which Dr Hope of Edinburgh distributes manures in his Lectures on Chemistry, are, 1. Those which furnish nourishment to plants; 2. Those which act by stimulating the vegetable fibre; 3. Those which operate by bringing the remains of organized bodies into a state fit for nourishing plants; 4. Those which ameliorate the texture of the soil; and, 5. Those which correct any noxious impregnation in the soil, inimical to vegetation. It is obvious that some substances may act in more ways than one; they are then arranged under that head which embraces their principal mode of operation.

known, must be considered only as calcareous. The good effects of gypsum (the sulphate of lime) are not yet experienced in Scotland. All these containing calcareous matter combined, or that soon must be combined, with carbonic acid, as stated in the last section, may be taken in the group, and considered in one view as calcareous: for though there be frequently a mixture of extraneous matter, some notice of these mixtures may be taken afterwards; and we proceed to examine some of the properties of calcareous earth, as it operates on the soil.

Calcareous earth, or lime, as we shall henceforth call it, has, of late times, been applied to the soil, in all quarters, to a great extent, for the purpose of promoting fertility, and frequently with uncommon success. It is of vast importance therefore to know something of those properties which have had such wonderful effects, and what has been the cause of failure where its operation has been less successful. But unfortunately our stock of knowledge on this subject is very meagre, notwithstanding the long and extensive use which has been made of it. The few following are such of its traits as have been noticed, which are all we have to enable us to judge of its effects in the soil.

Lime is extremely prone to combination, and never remains long in a simple state. Its affinity with carbonic acid is peculiarly strong, taking this acid from its combination with other subtances. In combination with some acids, it is soluble in water, but is oftener an insoluble compound.

In its simple or caustic state, it is said to dissolve in 680 times its weight of water: but when this solution is exposed to the air, the lime forms a pellicle on the top, attracts carbonic acid, and precipitates to the bottom, leaving the water sweet. In a shallow vessel, this will take place in less than 24 hours: when quicklime is mixed up with water, and spread very thin on a plain surface, in the open air, it regains carbonic acid as quickly, and becomes effete lime.

Lime takes in water, at all times, with great avidity, a great part of which it emits as freely. It holds, without dropping, about half its own weight.

The dry powder of quick lime affects neither animal nor vegetable substances. The hands of a person, who has wrought in it all day, are not in the least injured; and a rose immersed in it is more fresh, at the end of 24 hours, than if it had remained in the open air. But when the lime has gotten water, the skin with which it comes in contact is sodden, and the flower is blanched and disfigured. After the lime has become effete, it produces no such effect, though it has been said to promote putrefaction. A handful of fresh straw was laid in one shallow vessel, with effete lime under, around, and over it; a handful was put in another vessel, and surrounded in the same way with garden mould. Both were duly watered and kept always moist for a month; at the end of which the straw in the garden mould was more putrefied than the other. But quick lime, with the aid of water, suddenly destroys all vegetable substances. Upon the surface it putrefies the growing herbage, but does not appear to reach the roots, as a fresh verdure soon after arises. But when the roots of a growing plant are immersed in lime water, its leaves soon droop, and it does not recover, though the lime soon falls to the bottom, and leaves the water sweet.

When lime, used as cement or plaster, is exposed to stagnant air, or to the alternate influence of rain and frost, its cohesive power is destroyed, its particles separate, and it crumbles into dust. In this state it has been found to have an uncommonly good effect in promoting fertility, when applied, especially, to cohesive soils. Powder of lime spread, and allowed to lie and carbonate on the surface, seems to be acted upon in the same manner. At first it becomes hard and stoney under the foot, and after some time feels more mellow and friable. It is not known whether or not the carbonic acid, by which the parts of the lime were bound together, be liberated by this change; but it is certain these parts never again cohere, but seem rather to repel one another.

The solution of quicklime in water combines with oil, and forms a kind of soap. Even the carbonate of lime has an imperfect operation on oil somewhat similar, the two substances gradually forming together into a viscid coagulum.

Lime, whether quick or carbonated, has a strong affinity with the acids, by combining with which their antiseptic influence is withdrawn from substances which they kept in preservation, and these substances are allowed freely to putrefy.

Lime itself is not possessed of the necessary qualifications of the soil. Seeds planted in a flower-pot filled with pounded carbonate of lime, regularly watered, will vegetate feebly, but make little progress, and die without coming to perfection. In a flower-pot partly filled with garden mould, and carbonate of lime an inch and a half thick over it, plants put down their radicles straight through the lime, without ramifying or stretching sideways, till they arrived at the other mould. Even in a mixture, where lime was only one fifth, the plants were poor and sickly, and made no progress.

Lime and its compounds are always found in the ashes of burnt land vegetables: of course, it must be an ingredient in their composition; but it is a very inconsiderable ingredient, perhaps not the hundredth part of the whole plant.

These are a few traits in the character of lime. It is much to be regretted that the subject has not been more fully investigated. Perhaps what is here advanced may excite farther inquiry, and clearer discoveries may be made. Judging from these faint lights, the purposes for which lime is applicable to the soil in salts, which must become a part of the soil: its combination with others is soluble, and may be carried, with the ascending sap, into the bodies of plants, and constitute the lime which is found in the ashes of burnt vegetables: or it may be carried up in the saponaceous matter above mentioned.

Two questions, with regard to lime as a manure, have been much agitated among agriculturists; 1st, What is a sufficient quantity to a given extent of land? 2d, Whether that quantity should be given at once, or by repetitions at different periods?

As to the first, Lord Kames assigns 30 or 40 bolls (wheat measure) of shells as a proper quantity for a porous gravelly soil, from 50 to 60 bolls for a middling soil, and from 70 to 80 bolls for a strong soil, all per acre, and thinks even 100 bolls would not be an over dose for the last. * Mr Wright found 2 chaldrons, on new land, highly beneficial. But when he doubled the quantity, and laid it on land which had been limed before, the crop failed for three successive years, and the land continued in a worse case for some years after. † He concludes, therefore, that to make the application of lime beneficial, it should be limited within moderate bounds. The testimonies of experienced husbandmen, to the same purpose, are pretty general. On the contrary, the late Dr Anderson is decidedly of opinion that there need be no bounds to the applying of lime to the soil, but the consideration of the expense: ‡ and to confirm this, gives an instance of lime being laid on land 4 inches thick, which had no other effect than that of the crop being too luxuriant for a number of years after. But this ingenious gentleman must here have been under some mistake: for the luxuriant crop must have grown almost in lime alone; and every body knows that no plant will thrive in the carbonate of lime: and it is here asserted, on the evidence of experiments carefully repeated, that corn will not grow on a soil the fifth or the sixth part of which is lime: besides, it has been frequently experienced, that the crop has advanced more slowly, and been later in arriving at maturity, after a very abundant liming; and it may be presumed that a greater quantity would have had still worse effects. Lord Meadowbank also contends for a large quantity of lime §. He mentions soils containing one ninth of calcareous earth being nevertheless benefited by the application of more lime. His Lordship does not admit that any soil has been overlimed when the lime has been carbonated before it was applied to the soil: and he attributes all the injuries of overliming, of which there have been complaints from different quarters, to the application of lime in a caustic state. But there are reports of soils becom-

* Gentleman Farmer, p. 263.

† Communications to the Board of Agriculture, p. 118.

‡ Essay on Quick Lime. § Communications to the Board, p. 384.

ing too loose and porous for holding the roots of plants, or water to support them, by overliming, which does not appear to have been occasioned by the causticity of the lime. Fields in Stormont and Strathmore have lost all cohesion, and bear no grass, by the excessive use of shell marl, which is always in a carbonate state.* Carbonate of lime, after remaining in a damp situation, like decayed plaster, crumbles into dust, and not only refuses to cohere, but lies very loose and open. What the nature of this chemical change is, does not appear to have been examined; but the fact is certain. It is this trait in the character of lime which causes the faulty porosity in the soil. As it is very generally admitted that lime yields scarce any direct food to plants, but only adapts the soil and its contents for their nourishment,—as moderate quantities have been found to answer this purpose,—and very large quantities or too frequent repetitions, in some instances, to defeat it, it is surely most prudent to keep within moderate bounds, till longer experience have established a more certain standard for soils of different qualities.

With regard to the second question, some insist that land should have a large dose of lime at once; that smaller quantities given at different times produce no effect, and are altogether thrown away. Others argue, that the main use of lime being as an ingredient to improve the construction of the soil, it can only serve that purpose by being intimately mixed with the other ingredients, and that this mixing can be best effectuated by repeated applications. The argument on both sides rests upon the supposition of lime being an unconsumable substance; and the diversities of soil are not taken into consideration. But though lime carbonated be insoluble in water, it forms, as has been said, with some acids, soluble salts, and may also combine with the carbon and hydrogen of putrefying bodies. Such of these soluble compounds as are not carried up into the organs of growing plants, must be washed away in rains; and thus the proportion of calcareous matter be continually diminishing. Besides, the insoluble salts of lime, though they remain in the soil, may not be so useful ingredients as the carbonate, since all salts have qualities different from those of the substances of which they are compounded. The calcareous matter must therefore be always diminishing, by the abstraction both of soluble and insoluble salts: but experience has not yet established any rule to judge at what rate this consumption proceeds, or when it may be requisite to restore what has been wasted. As to the diversities of soil, the mixture of lime tends to separate the particles of strong clays for a time; but these particles have such a tendency to coalesce as often as they are soaked with water, that repeated applications of lime to separate them anew, may often

* Perthshire Report, p. 292.

be necessary. But if an open soil have as much calcareous matter mixed in its pores as to enable it better to retain water, additional lime, as it mouldered into the condition of decayed plaster, would excite an improper porosity, and thus diminish the fertility of the soil. The quality of the soil must therefore regulate the quantity of lime, as well as the repeated additions necessary: for strongly cohesive soils, a greater quantity or more frequent repetitions, to check the constant tendency of the particles to coalesce, may not only be safe, but advantageous; whereas large or frequent repeated applications would ruin open porous soils.

The application of lime has had such important effects, and has so much occupied the industry and attention of the rural part of the nation, that it has been thought requisite to enter largely into the foregoing inquiry, as well to warn the public to expect no more from the use of it than it is qualified to effect, as to excite more accurate investigation on this important subject, which is still but imperfectly known. This prolix dissertation may now be concluded with the following corollaries.

1st. Before the application of lime, the lands should be sufficiently drained and freed from water, which counteracts its operation in altering the construction of the soil;

2d. Lime should be spread while it is still in a powdery state, being then best adapted to mix intimately with the other ingredients of the soil;

3d. There are soils, the ingredients of which are so modified, and the whole so happily blended, as to possess naturally all the aptitude to fertility, which the application of lime can communicate to soils less fortunately constituted. On such, the application of lime is probably unnecessary expense;

4th. If a soil be so destitute of vegetable aliment as not to produce a close cover of herbage over its surface, it will be in vain to apply lime, unless accompanied, or preceded, by a large quantity of putrescible matters.

2d. *Non-Calcareous.*—Exclusive of all the arts and applications of human industry, it is well known that there are soils which naturally possess a greater aptitude to fertility than others. Sometimes these different shades of fertility are discoverable by inspection, and sometimes they are more incomprehensible. Natural fertility, however, appears, in some degree, to consist in earths which have lain and been modified in a different manner, being mixed and blended together. Thus, if a thin layer of earth (even less fertile than that on which it is laid) be spread on the surface of a field, and the two well mixed together, that ground will evince a greater degree of fertility than before. The same may be observed after any overturning of the surface, provided the upper soil have not been buried. Hence, too, the natural fertility of water-formed soils, where the torrent has torn pieces of earth from various places, and blended them together. Nature, it would seem, having set before us examples of soils fitly blended for fertility, and laid the materials, for amending those which are not, every where to hand, has frequently left the finishing to human industry. It is in the performance of this task, that the substances of which we are now to treat come to be ranked among manures, They are the following, viz. Virgin earth, sand, clay, burnt earth, matter left on the soil by irrigation, refuse of salt, ashes of wood, peat and coal, soot; all of which shall be noticed in their order.

Virgin earth, by which is meant a favourable mixture of the substances of which the soil is composed, lying in some neglected corner, and showing its aptitude to fertility by the close turf of sweet herbage which covers it. This ameliorates defective soils, either by itself or in composts. By itself it imparts some share of its own happy construction, as well as the vegetable food it has been storing up, while it remained at rest, to the soil on which it is laid. In composts it also absorbs and retains the putrid moisture oozing from putrefying substances, and serves as its vehicle to the soil.

Sand and *clay*, when applied on a soil of an opposite quality, must evidently correct its defects: and both have been applied for this purpose with considerable success. The quantity must be proportioned to the greatness of the defect, or otherwise it will be of little avail.

Burnt earth, that is, any of the mixtures of the earths found near the surface, torrefied in a red heat. This operation makes a change in the modification, which produces remarkable effects. When cohesive earth has undergone this, and is afterwards reduced to powder, all its tendency to coherence is lost, and its particles lie compact, without uniting. It seems to have the perfect consistence of a fertile soil: for corn springs quickly, and tillers abundantly on it: and if a little dung juice, from time to time be given, it will grow luxuriantly to maturity. It has also a strong tendency to promote fertility when applied on other soils. When brick-dust is sprinkled on grass, a deep verdure soon after appears. When a quantity is mixed into any spot of a corn field, a superior crop is observed for a number of years. Even a very slight torrefaction of the soil has a great effect. Mr Curtis of Lin had a succession of valuable crops by burning the stubble on a field. † It is surprising that the beneficial effects of torrefaction, which can scarcely have escaped the observation of any husbandman, has not brought it more in use. Probably burnt clay might, in many cases, serve instead of burnt lime; and surely the one could be more cheaply procured than the other. If torrefied clay, upon more extensive experi-

† Communications to the Board, p. 130—133.

ence, were found to have an equal effect with lime, it would never produce the mischief which has been experienced from o-verliming open soils. As its particles always lie compact, it would correct and not inflame the fault of such soils. Clay earth should be submitted to torrefaction before it be dry, that the water, swelling with the heat, may separate its parts, and prevent it from uniting in hard masses. There are some occasions on which a considerable store of this useful manure might be advantageously obtained. There are still, in different parts of Scotland, fields which, having lain long neglected, have a thick covering of mosses, heath, and other wild herbage accumulated on their surface. Whatever objections there are to exposing to the action of fire, the surface of cultivated land, bearing a sward of esculent herbage, which yields to putrefaction, and quickly becomes nourishment for a new race of plants, there can be none to the consuming of the refractory herbage of such fields, which resists putrefaction and does not yield support to a cultivated crop. A turf of no sparing thickness might be spared off such fields, as the stiff growth on it would keep it at some distance from the damp ground, and facilitate the drying; and, when dry, the bulk and inflammability of the herbage would roast a large portion of the earth, provided the sods were laid gradually round the fires, kept always in near contact with one another, and new ones added as the heat increased, never allowing the flame to break much through. By the effect of this smothered burning, a proper consistence would be given to the soil, the refractory herbage would be reduced to a soft cinder, which dissolves in water, and greatly promotes vegetation; and thus barren fields, which lie waste from the just apprehension that the expense of culture and manure, necessary for the improvement of them, would exceed the profit, might produce a plentiful crop at a moderate expense. Grass seeds might be sown along with the first corn crop, which would be of some value for a few years, till the occupier could provide manure to augment its fertility.

Matter left on the soil by irrigation.—The earths thus left, being brought together by the same means, must partake of the quality of water-formed soils. But, besides these earths, water, from the bowels of the earth, is frequently charged with much carbonic acid, which it quits when exposed to the air, and leaves among the herbage: and water from the surface brings along with it the spoils of vegetables, &c. which it must drop as it trickles along the meadow.

Refuse of salt contains earth, of which nothing more need be said. With respect to its salts, these and others shall be considered at the close of this branch.

Ashes and soot, as possessing earth, may be properly enough ranked in this order; but as wood and peat certainly are, and coal generally believed to be, vegetable substances, the articles above-named issuing from them, may be said to be derived from the vegetable kingdom. But, waving inquiry into their origin, they are here regarded as earths, and as such they are of a peculiar structure. Having passed through the vegetable system and the action of fire, they have undergone a double modification, and differ greatly from the common earths of the soil; and mixed with these, are excellent ingredients in it. They are also good absorbents, well adapted to convey to the field the solution of hydro-carbonic substances, and likewise promote the decomposition of such as are not dissolved. Soot contains a great proportion of carbon, which burns rapidly, leaving ashes nothing different from those of the substances from which it had issued. Part of this carbon has retained hydrogen, and is soluble in water, to which it gives the colour of dung juice, and has the same effect in promoting vegetation. Part is insoluble, and can scarcely be considered of any other avail in agriculture, than as an ingredient in the soil for which it is particularly valuable, its black colour absorbing the rays of the sun.

The ashes of wood contain vegetable alkali; soot, volatile alkali: the ashes of peat and coal, and refuse of salt, neutral salts of different denominations. Speculative agriculturists still dwell so fondly on the delicious nourishment which they suppose salts to administer to growing vegetables, that it seems to be proper to stop a little to investigate this matter, that sober husbandmen may not be misled by idle theories. Oils, alkalis, and acids, having been obtained from vegetables, it was supposed that they derived these substances directly from the soil in which they grew, it not being then known that these were compounds formed by the vital power in the organs of plants, and not to be found in the soil. If they were really found ready formed there, they would destroy, not promote, vegetation: for both alkalis and acids, and the salts formed by their union, when applied to the roots of plants, occasion immediate decay. This is proved by the experiments of Sennebier, Parmentier, and others; and any one may easily satisfy himself on that head. He will then find, that though some of them are less, and some of them more deleterious, a very small quantity of any of them dissolved in water, and poured round the root of a plant, will put an end to vegetable life. Common salt, which is indeed one of the mildest poisons, has been recommended by many as a manure; but there is no certain testimony of its having proved effectual. The experiments of Mr Fenna, communicated to the Board of Agriculture, prove the reverse; and no certain conclusion in its favour can be drawn from those of the Rev. Mr Cartwright. * But the

* Communications to the Board, p. 372. The alkalis and their compounds, such as culinary salt, &c. however, might be of great importance in agriculture, if they could be had in sufficient abundance, at a low rate; as, when sown on the surface, they kill the snails and grubs by which cultivated plants are devoured in the early part of summer.

advocates for salts, when they are obliged to admit that vegetables derive no direct food from salts, contend, that these substances either whet the appetite, or fit the food for the vegetable palate. It would be improper to swell this work by entering into discussions upon such dark and doubtful topics. The husbandman's duty is to give his soil the proper consistence, and store it with known vegetable aliment. When that is done, the condiment, if condiment be necessary, will not be wanting.

3d. *Mixed.*—The last order of fossil manures is, substances in which calcareous is mixed with other earths. These are, stone or rock marl, clay marl, shell sand. To these may be added schistose substances, containing some calcareous matter, but scarce enough to deserve the name of marl.

Stone and clay marl probably differ only from each other on account of the situation in which they have been respectively lodged. The former, laid on a dry bed, and compressed under a dry covering, is indurated like a stone; the latter, lodged in a wet hollow, and covered with spongy matter, has continued soft. These mixtures seem to be happily modified. After being sometime exposed to the weather, they crumble into friable matter, and do not form again into cohesive masses. Neither do these kinds of marl, like shell marl, occasion a faulty porosity in the soil, where they have been copiously applied. Fields are to be seen on which they have been laid, at the rate of 400 cart loads and upwards, perhaps 40 years ago, which, whenever they are laid in grass, bear a close cover of the sweetest herbage. It would seem that the other earths are so modified as to counteract the repulsive quality of the calcareous, and preserve that medium of consistence so favourable to permanent fertility.

Shell sand, being a mixture of calcareous and silicious earths, is evidently an appropriate manure for correcting the defect of too cohesive soils; and by it, such soils, when they lie near the coasts, where this substance is found, may be greatly ameliorated.

The schistose substances mentioned, are chiefly found in the districts where the coal strata lie. They are laid in thin laminæ over one another, and frequently covered with a bed of freestone. They are hard, and quite sterile in their native state: but in deep sections of the country, where the face is exposed to the vicissitudes of the weather, they gradually moulder down, and lie soft and mellow at the bottom, showing no tendency to coherence. Where any considerable mass of this matter is formed, plants of different kinds are found growing in it with great luxuriance. When they are spread on grass ground, and lie till they crumble with the weather, a deep verdure ensues. It would appear therefore, that they possess the true consistence of a fertile soil; and where they could be raised on easy terms, a thick coat of them laid on any thin poor land, in the immediate neighbourhood, and allowed to lie and moulder in the air, would make a great improvement on such ground.

II. ANIMAL MANURES.

ALL organized bodies, as has been already observed, are compounds formed by the vital power. When that power ceases to act, the combination begins to dissolve, and the constituent principles go to the formation of new organized bodies. By this continual circle of formation, existence, and decay, what has been animal matter nourishes vegetables, and these arise for the support of animals: and by this mysterious round, the bounty of all ruling Providence is perpetually distributed. Animal substances employed as manures, being of different qualities, require to be separately considered. They are the flesh, the intrails, the skin, wool and hair, horns and hoofs, blood, urine, bones, dung.

The flesh of animals is compounded of the same ingredients with vegetables, and contains besides, a considerable quantity of azote, the largest principle of atmospheric air. Such of it as is not consumed by living animals, is subject to a very rapid putrefaction, and soon becomes fit to nourish growing plants, on which it excites a most luxuriant growth. The intrails, as manure, differ nothing from the flesh. The sudden putrefaction of these substances, and their unfitness for such minute division as to mix intimately with the soil, make them less suitable for using as manure alone. On that account, as well as for their disgusting appearance and offensive fetor, they are commonly smothered up and mixed with other matters, and are exceedingly well adapted to promote fermentation in more refractory substances. The skin, and its covering of hair and wool, the horns and hoofs, after the animal juices are evaporated, are not subject to putrefaction, like the more succulent parts. Formed of the same ingredients, they might be expected to produce the same effect in fostering vegetation: But whether it is, that, being always exposed to the external air, they are hardened by combining with oxygen, or by what other cause, they do not of themselves submit to the putrid fermentation, but slowly yield to the wasting power of time. Skins have been recommended as a manure; but there is no experience, to be depended on, respecting their value for that purpose. Wool and hair, particularly in the article of woollen rags, have been frequently used as manure; but though extolled for a time, they are now almost neglected. This, perhaps, has proceeded from the imperfect decomposition of the manure disappointing the expectations of those who used it. But though wool and hair resist corruption, they dissolve completely in alkaline lee, and are then a rich manure. Horns and hoofs are likewise durable compounds: but though they resist putrefaction in a mass, when finely shaved, they dissolve in the soil, and occasion a vigorous vegetation. Blood and urine are highly concocted animal fluids, in which salts are generated, and they are subject to a very rapid putrefaction. When poured fresh and unmixed on the ground, they kill growing plants; but if diluted with a large proportion of water, and agitated in it, they encourage vegetation: or, when they ferment anew, putrefaction ensues: their salts are decomposed: and as they not only contain vegetable nourishment in solution, but are powerful solvents of it in other bodies with which they are mixed, they are very valuable as manure.

Although it seemed requisite thus rapidly to recognize the various properties of different animal substances, considered as manure, there is but a small part of them applied directly to that purpose, being in request for various others, for which they are of higher value. But there are two other substances not described, differing somewhat from all the rest, and greatly from each other. Bones are a compound of a most unperishable kind; burnt bones being frequently found, the organization of which is still preserved entire since the time that the Romans possessed this island. They are now known to be a compound of phosphoric acid and lime (phosphate of lime). Mr Kirwan recommends bone dust as an appropriate manure for wheat, in which some phosphorus is found;* and Mr Chatterton had a succession of rich crops by applying it to a field. § But it does not appear that a combination so unperishable should yield that ingredient to a crop of wheat growing over it, or that this substance, after the oil and mucilage contained in it is exhausted, can serve any other purpose than as an ingredient in the soil. Mr Chatterton was probably, therefore, more obliged to the contents of the bones, than to the bones themselves. Dung is partly of the substance of the animal which voids it, and partly some of its food undigested and little altered: of course the dung of graminivorous animals, which is one of the most considerable articles of manure, is partly animal, partly vegetable matter, and must be more fully considered when we come to Composite Manure.

III. VEGETABLE MANURE.

VEGETABLES are either arboreous or herbaceous. The arboreous are such as continue for a series of years to increase in size by annual enlargements and elongations. Their principles are thus formed into more durable combinations, and do not quickly return to nourish a new race of vegetable beings. Some of them are however occasionally brought to that use. The shavings of board, small chips, and saw-dust, macerated for a time in putrid water, gradually decompose in the soil, and become the food of

* Essay on Manures. § Communications to the Board, p. 127.

growing plants. The leaves which trees annually shed, and the soft unripened shoots of a season, partake of the qualities of annual plants.

Herbaceous plants are such as spring from the ground, and arrive at maturity in the course of one season. Their existence is either terminated by the course of nature, or they are cut down before the natural period of their existence arrives. A separation of the principles of which they are compounded is then ready to commence. The former, however, being more hardened in the air, resist dissolution more than the latter. The process by which organized substances are decomposed and fitted again to enter into the composition of new plants, is called Fermentation. This process has perhaps been less attended to than its importance demands: but as it is highly interesting in treating of manures, and can be best traced in its operation on vegetables, it may be proper here to take as distinct a view of the steps by which it proceeds, as our imperfect knowledge will admit, to enable us to judge of the best mode of preparing the substances destined for manure.

Fermentation does not operate on frozen bodies, or when the temperature is below the freezing point. After the natural juice is evaporated, and vegetables become dry, they do not ferment till they have imbibed water to moisten them: and though Fourcroy found fermentable substances decompose in a vacuum, free access to the air is acknowledged to be necessary to active fermentation. Thus, heat, water, and oxygen, are said to be the three agents of fermentation. The sweet juices of ripe fruit or any liquid vegetable extract, containing sugary matter, undergo three distinct stages of fermentation; the vinous, the acetous or hot, and the putrid. When the first commences, some oxygen is absorbed from the surrounding air, sensible heat is diffused, carbonic acid gas is copiously formed and emitted, by which the carbon and oxygen of the subject is diminished, and the sugary matter converted into spirit: In the next step of the process, oxygen is copiously absorbed, the heat is considerably increased, hydrogen and carbon escape in carbonated hydrogen gas, the spirit is decomposed, and the acetous acid is formed. During the last or putrid stage, ammonia is formed, carbonic acid and carbonated hydrogen gas escape, and the acid is decomposed; gases still continue to escape, till all the principles capable of assuming a gaseous form are dissipated in air, and nothing remains but some refractory carbon, a little earth and salts.

A short account of the process of fermentation on vegetable substances in a liquid state, to which philosophers have paid most attention, is here given, to enable the reader to form some idea of the same process, as it operates on entire vegetables in a solid state, from the faint traces which follow; this having been still less attended to. As the substances destined for manure contain little or no sugary matter, the three stages of fermentation cannot so distinctly succeed each other in them; but the conclusion is similar. The process operates differently, according as the proportion of the agent, water, is greater or less. When a quantity of vegetables, gathered into a heap, possess no more water than just enough to excite fermentation, heat is quickly evolved, and increases to such a pitch, that fermenting vegetables have been known to take fire; the hydrogen of the plants is liberated; and, combining with oxygen, forms water, copiously escaping in vapour, and forming in dew drops on detached objects; much of the carbon, combining with oxygen, is continually escaping in carbonic acid gas, which is felt in the air at some distance; the bulk of the mass rapidly diminishes; its parts, which become very flaccid, matting together like felt, and excluding the air. It is worthy of remark, that heat increases as the parts coalesce more closely, and is greatest near the centre. Can this be from oxygen absorbed, or from the disengaged caloric of the vegetables? The heat does not greatly subside till the bulk of the mass be very much reduced. The vegetables are then become brown, with a white mould forming on them, and so brittle, that they may be rubbed almost to powder in the hand. As soon as rain falls, the structure of the vegetables in a short time disappears. Without attempting to trace the later changes which this residue undergoes, it shall only be observed, that at length nothing is left but a little vegetable mould, consisting of insoluble or very refractory oxid of carbon, some earth, and salts.

Straw, immersed in water, and kept under it, in the average temperature of 50°, soon began to send air-bubbles to the surface. In a few days the water began to have a slight acidulous taste, and somewhat of the smell of white wine. Soon after, the intestine motion increased, and the smell was like that of steeping flax, which daily became stronger, and the heat of the subject rose some degrees above that of the surrounding temperature. The heat subsided at the end of 27 days; and the smell was then that of litter which had been soaked some time in horses' urine. At the end of seven weeks the liquid was of a deep brown colour, and felt viscid. By evaporation, it left a hard, black, coally matter, which burnt with difficulty. It softened when exposed to the air, and dissolved easily in water; and this solution gave clear evidence of its nourishing quality, when applied to the roots of young plants. The straw was also of a brown colour; the fibres still retained some strength; but the parenchyma, by which they are united, was dissolved. When covered in the damp soil, it soon became black; and against the end of the season, the organization was annihilated.

Such are the operations of that general law by which dead vegetables are prepared for nourishing those which are living. If the agent, water, be in sufficient abundance, as the combination yields to putrefaction, the ingredients dissolve in it, and are thus carried to the organs of new plants. But there are vegetable substances sometimes used as manure, possessed of peculiarities which merit attention.

Sea-weed, which is so copious a fund of manure along the shores, according to the analysis of Sir James Hall, is chiefly valuable for the great quantity of soluble gluten which it contains. * Of course, it contains the food of the plants ready formed, without the aid of putrefaction. Hence it is the most approved practice to plough it, fresh from the sea, directly into the soil, to prevent this gluten from being evaporated and lost. But as these plants are liable to a very active fermentation, they may be used with propriety to excite fermentation in more refractory bodies; and in this process their own refractory fibres would also be decomposed.

Malt-dust, the slender radicles which malting barley puts forth, containing chiefly mucilage, is also soluble without fermentation, and ready to accompany water in nourishing growing plants.

Rape and Lintseed cake, being the comminuted farina of these seeds deprived of the oil, like starch, will, no doubt, quickly putrefy in the ground, and become soluble in water. But neither these nor malt dust are in great abundance; and, being found useful as the food of animals, will mostly go through the animal system, before they be used for the nourishment of vegetables.

IV. COMPOSITE MANURE.

It not being common to apply animal or vegetable substances separately as manure, it seemed sufficient to take a short speculative view of their respective properties. The compositions of the different substances used in common practice, are more interesting parts of the subject, and shall now come under discussion. This branch may be considered under the two following heads.

1st, Such compositions as casually occur in the course of domestic economy;

2d, The more complex compositions of these with other substances.

Farm Dung is the principal article under the first head, that is, a mixture of the excrements and litter of domestic animals, augmented by continued additions, to which prudent husbandmen add all inesculent herbage, and every kind of putrescible matter. The excrements, partly animal juices, and partly undigested vegetables, being moistened and heated in the bowels of the animals, and the litter moistened with their urine, the whole is ready for putrefaction, which is left to the judgment of the

* Berwickshire Report, p. 375.

husbandman to conduct. Some mention is made, in the last Section, how this business is generally conducted. In some of the best cultivated districts, it is shortly this:—The dung is laid loosely, no cattle allowed to trample upon, and compress it. It is carried from time to time to the fields, laid in long narrow heaps, repeatedly turned and watered, till it be completely rotted; if not completely so in one season, it lies to rot till the next. The mark of its being well prepared, is when *it can with difficulty be lifted on either fork or spade.* † Thus, the putrefactive fermentation is hurried on with the greatest rapidity, and carried almost to the close of the last stage, which, if there can be any reliance on the foregoing description of fermentation, must appear to be a very prodigal procedure.

It is not now doubted, that a great proportion of the component parts of both animals and vegetables is capable of passing into an aëriform state. When a mass of these substances is laid loose and open, exposed on all sides to the external air, even though water be sometimes thrown upon it, that water will partly sink to the bottom, and partly be evaporated in the air; and this agent will always be present, only in the lowest proportion, which is that in which fermentation operates with the greatest violence, as has been already shown. Through a mass thus lying open, the air impetuously rushes, its oxygen is absorbed, much caloric is liberated, and a violent heat ensues: the combination is quickly dissolved: the oxygen combines with the carbon of the substances, partly to form carbonic acid gas, which flies off, partly to form oxid of carbon, which, if not insoluble, is very difficult of solution: the hydrogen is liberated, and, either combining with oxygen, ascends in steam, as we may see, or with azote, and ascends in volatile alkali, as our senses inform us; and thus the use of a large proportion of the mass is lost. In the mean time, the heat probably promoting the combination of oxygen with some of the hydrogen and carbon of the substances, not disengaged, is forming acids, and these acids combining with alkali and earth, forming salts, which, as has been already stated, are not the food of plants; and the real food is dissipated in acquiring them.

Some agriculturist, prejudiced in favour of the practice he has followed, which perhaps, on account of other favourable circumstances, may have been prosperous, may probably read this with a supercilious smile. But since the solution of decayed organized bodies is the great nourisher of vegetation, to have the command of it in abundance, must be a valuable acquisition to every cultivator of the ground; and this, a fermentation, accelerated and carried too far, must consume by perhaps more than a half of what the same substances should have yielded. If any doubt of this be still entertained, let a quantity of dry vegeta-

† Report of Ross and Cromarty.

bles be submitted to combustion in the open air, and it will be seen how small a portion remains, after all the volatilizable parts are vanished. Now, a rapid fermentation is only a silent combustion, the final result being the same. But besides the loss of hydrogen itself thus dissipated, its use as a solvent is also lost. The hydrogen of vegetable, and the azot of animal substances are the best, and perhaps the only solvents of carbon; and the liquid compound formed by them, as it issues from putrefying substances, is the very essence of vegetable aliment.* It would seem therefore highly economical to restrain the fermentation within moderate bounds, and mix the manure with the soil before it has proceeded too far.

But there is a notion handed down by tradition, that rank or fresh dung is injurious to vegetation; and those who hold that notion, support it by a position advanced by a learned Lord, whose valuable communications have been already alluded to. Lord Meadowbank, in the introduction to his inestimable essay on the preparation of peat moss for manure, says, *the early changes (in the putrefactive fermentation) appear rather to be pernicious to vegetation, when plants are exposed to their direct effect; the later changes powerfully promote the growth of plants.* His Lordship is certainly quite correct in this as a general position. In all subjects which contain so much saccharine matter as to be capable of regularly undergoing the vinous, acetous, and putrid fermentations, both the spirit and the acid are pernicious. Dr Hales made a plant imbibe spirits which occasioned the immediate cessation of vegetable life: † and by some late experiments it appears that acids are equally deleterious. ‡ Such a subject therefore promotes vegetation only in the later changes, when both spirits and acids are decomposed. But the composite substance in question, containing little or no sugar, is not of this description: the ingredients, however, being of different qualities, must be examined separately. None of our dead vegetables, except

* Sennebier expresses a doubt of plants being nourished by this solution, with which it is presumed no practical agriculturist will concur. He placed sprigs of the raspberry plant, without roots, in vials filled with dung juice, with a mixture of the same liquid and water, and with pure water. The sprig in the unmixed juice imbibed only 20 grains, and withered in 4 hours; the sprig in the mixture imbibed 40 grains, and withered in the course of a day; the sprig in pure water had imbibed 800 grains in that time, and was still fresh. This experiment was in part repeated. On two small vials, one filled with half dung juice, half water, the other with pure water, two sprigs of mint, with roots attached to them, were placed. The plant on the first did indeed for some time imbibe less than the other. Fresh water was daily added, to supply what had been imbibed, till the mixture became limpid, and the plant on the one vial, imbibed as much as that on the other. During this time the plant on the pure water had made little advance, but that on the mixture had a deeper green, and had put forth many leaves.

† Vegetable Statics.

‡ Naismith's Elements of Agriculture, p. 67, 68, and 74.

such as contain tan and gallic acid in a concentrated state, are pernicious to vegetation, when they begin to be decomposed, if they are not laid so thick over growing plants as to smother them. On the contrary, wherever straw lies thinly scattered, a superior verdure arises, in a short time. The animal substances of the composition are somewhat different from one another, and differ much from entire vegetables. The dung of domestic animals, as has been already said, is partly animal matter, and partly vegetable, on which the first changes have commenced; but in its most recent state, it is not pernicious to vegetation. When the parts of horses' dung are a little separated and scattered on grass ground, the herbage is not injured, and after the first shower, a fine verdure appears. The dung of sheep, when it is not accompanied with urine (which indeed suspends vegetation where it falls), has the same effect. The dung of cattle, being cohesive, smothers the herbage on which it falls; but nothing like a pernicious effect is to be seen around the edges: so far from it, after the first rain, the growth is more vigorous; and if the dung be removed in time, the herbage will be found not to be killed, but blanched by being excluded from the light, and soon recovers its verdure, and becomes more luxuriant than before. Blood and urine, which kill plants, when recently applied, have, in the process of their formation, undergone changes, and have generated salts: hence they are injurious to vegetation till these deleterious compounds are decomposed, which soon happens in the course of putrefaction, to which they are prone; and their injurious salts are quickly dissipated in the mass of the dunghill. Nor has it been discovered that the composition of the above substances in the dunghill, is more pernicious than the most innocent of its component parts. On the contrary, common observation and experience instruct us, that as soon as putrefaction commences, the mass is continually yielding a brown extractive matter to the water it contains; and this liquid is known powerfully to promote vegetation, even in the earliest periods of putrefaction, provided it be not too much concentrated, or in too great quantity.

But it has been said that it is not the juice, but the gasses which issue from this composite mass, in the early stages of fermentation, by which vegetation is injured. It is admitted that these gasses unmixed are indeed hostile to the growth of plants exposed to their direct effect: but how can that occur to plants in the field, growing in the open air? And a mixture of those gasses, either in the soil or in the air, powerfully promotes vegetation. Ruckert watered the earth, in which he had plants growing, with water charged with carbonic acid gas, and others with plain water, and found the production of the former to that of the latter, as 25 to 15. Mr Young made hydrogen gas pass through the earth in pots in which plants were growing, and found the vegetation thereby promoted.* And by the experiments of Priestley, Saussure, &c. it appears that a moderate mixture of carbonic acid gas in the atmosphere of growing plants greatly promotes vegetation. But, in fact, the learned Lord does not mean, by the above general position, that the fermentation of animal and vegetable substances, preparing for manure, should be violently excited, or continued *till the substances are decomposed and reduced to their first principles*, as some doctors in agriculture have taught. In his letter to the President of the Board of Agriculture, he explicitly declares that moderate compression of this composite substance, as it excludes the too free ingress of external air, is proper; that it should be applied to the soil when it is but imperfectly fermented, and while the process of fermentation is going on; and to this purpose, he adduces the evidence of gardeners, who know that dung which has been used in hotbeds is of little value compared with fresh dung.† As the gases which are disengaged and dissipated by a rapid fermentation are the real ingredients of vegetables,—as all the aliment which human industry can bestow to promote the growth of plants, must be conveyed in solution to the roots, it would seem extremely preposterous and unfrugal to expel any of these ingredients in the air, which might be detained in solution.

But those who reduce manure to the last stage of putrefaction before they use it, seem to think those volatilizable ingredients must necessarily fly off, whatever be the mode of preparation;‡ and the extreme specific levity of hydrogen makes that supposition more plausible, with respect to that gas. But notwithstanding the great specific levity of hydrogen, which impels it to mount to the etherial regions, it has other propensities, which frequently detain it long below. By the force of affinity, it cleaves to phosphorus in marshes, rotten wood, fish, &c.; it cleaves more strongly to carbon in the composition of oil, a combination so durable that it is not relaxed by the process of the soap manufacture, by which it is made soluble in water, and then proves the nourishment of growing plants. The attachment of hydrogen to carbon, in the juice of farm dung macerated in water, though not so strong, is somewhat similar; as is evinced by the oily appearance and clammy feel of this liquid, and the strong smell of wet hydrogen which it emits when stirred. Nor is the lavish waste of carbon, expelled in carbonic acid gas, more necessary, in the preparation of manure. The absorption of oxygen into the mass is less, in proportion as the water contained in it is more abundant; and consequently, when there is plenty of water,

* Annals of Agriculture, Exper. 19. & 37. † Communications, p. 384.

‡ All smelling substances emit their peculiar aroma, by which the olfactory organ distinguishes one substance from another; but the bulk or value does not seem to be sensibly wasted by such means. When a wasteful emission occurs, it is the violence of fermentation which is the cause of it.

the fermentation is moderate, and the emission of carbonic acid gas inconsiderable: but these volatilizable principles are at length disengaged and dissipated in air by a continued fermentation. Mr Young, the diligent experimenter above cited, submitted different substances, in a retort, to a red heat, and received the gases which came from them: from an ounce of the new fallen excrements of domestic animals 98 measures of gas, at an average, was emitted; and still more from an ounce of fresh straw: From an ounce of the excrements and litter of a new dunghill, 88 measures; but from an ounce of that which had been turned and fermented for a year, only 38¾ measures. Thus a rapid fermentation, and the long continuance, appears, in every light, to be attended with very great waste.

But, though it were possible, by the means of fermentation accelerated or long continued, to render this composite mass all at once capable of solution, before it were committed to the soil, without the great waste which we have been considering, the general fertility of the country would not thereby be advanced, but injured. Cultivated plants would either be pushed up with unproductive luxuriance, the first year, leaving little aliment for those of the ensuing; or, if the solution were in great excess, vegetation would be suffocated: for even the most nutritious aliment proves poisonous, when in excess. Three peas were steeped, for 24 hours, in a tea cupful of strong dung juice, and three in plain water: each three were planted, half an inch deep, in separate flower-pots filled with garden mould, and the liquid in which they had been steeped poured into the pots over them. Those which had been steeped in plain water appeared above ground 30 hours before the others. Both advanced; but those in the dung juice had the most weakly appearance. When the plants were about four inches high, the lower leaves of those fed by the dung juice wallowed and fell off; and in about four weeks after the plants died, though they were daily watered, while those to which water only had been administered, continued healthy. Thus it appears that an excess of the most nutritious solution is prejudicial to vegetation, particularly in its early stages; and it would appear, upon the whole, that to restrain the fermentation of the mass, by laying it compact, and filling the interstices with a sufficient proportion of water to keep it soft and disposed to solution, and mixing it with the soil before it be wholly decomposed, is in every respect most advantageous. It then yields its solution slowly, and in proportion to the demand of the plants which are meant to be cultivated.

As the general fertility of a country, other circumstances corresponding, must always be greater in proportion to the abundance of organized spoils, in a soluble state, with which its soil is stored, it must certainly be of the highest importance to know how the greatest quantity of this valuable substance may be obtained, so as to supply the demands of annual vegetation in regular succession. It has therefore been thought necessary to inquire, at considerable length, into the nature of that process, by the agency of which the continued round of existence, decay, and resuscitation, is promoted, that we may be the better enabled to judge how this agent may be most beneficially employed. In the execution of this task, much technical language has been used, to which the unlearned reader may perhaps object. But, in treating of such topics, it was found necessary to employ the nomenclature used by those who have made them their study, there being no terms in common language by which the same ideas can be properly conveyed. As pains, however, have been taken to explain these terms, as we have gone along, by keeping these explanations in mind, it is hoped no one will be at a loss to comprehend what has been above advanced. In tracing the changes which occur in organization and decomposition, nothing is more staggering to the unlearned, than the doctrine of viewless air forming parts of concrete bodies. But it is necessary here to believe, that HE, who formed all things of nothing, can also form solid bodies of liquid air.

We now proceed to submit to the judgment of the public a few thoughts on the means by which the putrefactive process may be managed, so as to bring such organized substances as are at the husbandman's command to a soluble state, with the least possible waste, which it is proposed to usher by the following aphorisms.

1st. Soft and succulent vegetables are susceptible of more easy and full solution than those which contain confirmed ligneous fibres; and the succulent parts of animal bodies, containing azote, are more soluble than vegetables.

2d. Substances, become putrid, facilitate the putrefaction of any that are still resisting, with which they come in contact.

3d. Animal and vegetable substances, immersed in water, putrefy, and gradually dissolve, without generating much heat: the putrefaction goes on without ceasing, so long as they are kept wet, the component parts diffusing in the water, apparently still in a state of combination.*

4th. It has been already observed, that dry vegetables preserve their organization unimpaired, so long as they are kept dry; that when only wetted and thrown in a heap, heat ensues, and the decomposition is sudden; that, when immersed in water, the decomposition is gradual and slow. The changes which take

* That the combination of carbon, with the other ingredients of the substances, is not annihilated in this solution, is evident from this, that charcoal is not soluble in water; whereas the solid matter left after evaporating the solution, is eminently so, attracting water from the air, and becoming soft when it is exposed; and dissolving in water in all proportions.

place on the excrements of domestic animals. is not much different. The dung of cattle, when quickly dried, continues uncorrupted, while it is kept so: even that of horses, which often ferments very quickly, if a new fallen ball be completely dried, it is no less incorruptible. When these substances, before being dried, are put in water, they gradually dissolve, till almost the whole is a semi-liquid; but after being dried, they dissolve partially and with difficulty in water. Is it being exposed to light or oxygen, or both, which produces this alteration? Similar changes appear in the colour in different situations. When new fallen, the colour is a dull olive; when kept wet, and smothered in the mass, they become blackish; when dried, and for some time exposed to light and air, they harden, and whiten. By whatever agency these changes are effected, it is certain that long exposure injures the solubility.

5th. When the mass is fermenting, if it be turned out and separated, the process of fermentation is quickly suspended; and it is probable the hardening process commences soon after.

6th. When the solution of this composite is evaporated, and the vapour collected, it is found to be clear and tasteless water, and the concrete residue again dissolves in water. and is in every respect the same as before evaporation. When the solution is poured upon mould in a flower-pot, with an inch of clean washed sand at the bottom, the water, as it oozes away, may be received quite limpid at the lower aperture.

7th. Surface mould facilitates the decomposition of any part of fermenting dung with which it comes in contact; and by exciting the fermentation, a mild heat is produced.

If these aphorisms are just, they may assist in regulating the conduct of the husbandman in the preparation and application of dung; and reference is meant to be made to them in what follows.

All kinds of weeds and inesculent herbage, from tillage and pasture fields, waysides, by the sides of fences, and wherever they grow, should be gathered at, or before the time of flowering: The young succulent shoots of trees and shrubs, the leaves of trees shed in autumn, river and pond weeds, the grassy scourings of open drains and ditches, and every vegetable not otherways useful, should be taken to augment the dunghill. To these, one subject, not much attended to, might make a considerable augmentation. In lands occupied by repeated tillage crops, especially such as are friable and open, the *triticum ripens*, *poa trivialis*, *agrostes*, and some others, extend their roots everywhere through the soil, an inextricable plexus, injuring every cultivated crop. These are generally known by the name of Quickens, or couch grass roots. To free the soils of this nuisance, it is necessary frequently to turn out the roots by repeated operations of the plough and harrow, in a dry time. These roots have been sometimes made manure, but are oftener thrown aside or burnt. These laid on a dry spot, and turned till the power of reviving be fully destroyed, would greatly augment the vegetable matter of the mass, and convert an enemy to an useful friend.

From the foregoing examination of organized substances, and of the process by which they are prepared to pass into a new state of organization, it would appear, that, of the two great agents, water and oxigen, the former should be in the largest admissible proportion, and the latter in the least. In this state, the substances dissolve in water, before the combination is altogether annihilated, while they are still soluble, not being made refractory by combining with oxigen, by the heat of a rapid fermentation, and by the escape of the solvent, hydrogen. For this purpose, an excavation, large enough to hold all the substances to be prepared for manure, daily increasing in bulk, for a given period, would be a proper receptacle. It should be made to hold water like a cup, and at the same time the margin should be raised so much above the common level as to suffer no water to flow spontaneously into it, and wash away the solution, as the substances dissolved. Here the excrements and litter of domestic animals, together with all kinds of putrescible substances above enumerated, should be continually laid, mixed, and regularly spread with a level surface. These should be somewhat compressed; and if enough of rain has not fallen, water should be thrown on them, as well to fill the interstices, and prevent the too free admission of air, as to macerate the substances, and keep them always in a soft and soluble state. The scrapings of passages, where straw may be scattered, and cattle passing, should from time to time be added. Chamber lie, soap suds, and all kinds of foul water, should be thrown over the mass; and any urine of animals which is not absorbed by their litter, should be carefully collected, and applied the same way.

It will probably be objected, that by the air being so much excluded, the fermentation by which organized bodies are decomposed, in which it is a necessary agent, will be suspended. But Fourcroy has proved, that most fermentable substances decomposed in a vacuum: and as water, in this putrid state, is still decomposing, the oxygen, thus disengaged, will serve the purpose of a slow fermentation. The mass will indeed remain, for a considerable time, not altogether decomposed; but the affinity by which the parts are held together, is greatly weakened by being macerated in putrid water, and the whole is gradually dissolving. There is another objection, which probably has some weight with those who have the management of composite manure. The organization of the straw in litter, not being quite destroyed, the mass is held together by it, and by the water contained in the mass, which makes the lifting from the dungstead much more laborious, and the ſpreading on the field either more imperfect, or requiring more time and pains to feparate the cohering clots. The labour of lifting is fomewhat facilitated by cutting the mafs in perpendicular fections, at fhort diftances, with a fharp fpade; and the additional trouble of lifting and fpreading, which dung in this condition occafions, is nothing compared to the vaft advantage of having almoft the whole preferved a foluble mafs, by conftant maceration in putrid water, inftead of diffipating a great proportion in the air, and rendering a part of the remainder refractory by a rapid fermentation.

Town dung, as has been already obferved, differs only from farm dung, as containing a greater proportion of diffolved or very foluble animal matter, and earthy fubftances. Having, in the laft article, difcuffed, at great length, the management of undecompofed putrefcible matters, it will not be neceffary to add any thing here on that fubject. Befides, this fubftance does not come under the management of the hufbandman, who muft take it as he finds it. Nor can the citizen pay greater regard to it, who throws all offals afide, and thinks only of the price they will bring. The fubftance is valuable to the hufbandman, however, not only on its own account, but alfo on account of its greater putridity, facilitating the putrefaction of others with which it may be mixed. See *Aphorism* 2d. The putrid liquids of the city would be no lefs valuable, could any fyftem be eftablifhed to fpread them over the furface of the country as manure. The former cefs pools of Quaker Miller, and the more recent irrigations over the links of the Forth, near Leith, by which the fertilizing fediment from Edinburgh is made to raife a luxuriant vegetation on grounds formerly barren, is an example of what this enriching liquid might effect. There are few inftances, indeed, where it can be applied with fuch advantage as this; but if means were ufed to collect and concentrate it a little, it might be carried in veffels for fome miles, and, from its enriching quality, be found profitable, either to be fprinkled on the ground, or poured on abforbent fubftances. Much of this liquid is abforbed by afhes and other earthy parts of this compofite, where it is fafely lodged with little danger of being carried off by expofure to the weather, as the earths ftrongly retain the effence of organized folutions. *Aphorism* 6th. For this reafon, this compofite fuffers lefs than farm dung by being carried to the field, and laid in heaps in the open air: and juft fo much lefs as the proportion of earthy fubftances contained in the mafs is greater.

2. The more complex compofitions of calcareous or organized matter with other fubftances.

All thefe are known, in rural language, by the general name of compofts. They are either made up of lime mixed with fome fubftance on which it is fuppofed to act; or the compofite fubftance of which we have been treating under the name of dung ufed for a fimilar purpofe; or both lime and dung made up with other matters in the fame heap.

Lime is frequently mixed either with the mould of ſome headland, where much ſoil is accumulated, or the earth is taken from ſides of ditches, or fences, or drained marſhes, on which a thick turf of herbage is formed. Theſe laſt, as containing a greater proportion of organized matter, are ſuperior to the other. The lime of theſe compoſts ſhould be quick, but reduced to powder, and not in ſhells; as the heat, generated in ſlacking lime, ſears and hardens the ſubſtances with which it comes in contact, inſtead of mellowing them. Swarded earth ſhould be laid up in thin heaps, expoſed to the viciſſitudes of the weather for ſome time, that the parts of the ſods may begin to ſeparate before mixing with the lime. A turning or two will incorporate the materials, and then the compost is ready to be laid on the field. By this mixing, the earths of the compost seem to undergo a modification, which has produced a good effect on the fields where such composts have been applied. But the most important purpose of mixture of lime is that by which peat moss is converted into a rich manure. Lord Meadowbank, from his own experience, is of a different opinion. He found the lime dried and hardened the peat moss. There might probably be some mistake in the management: we shall, therefore, here give a receipt for that purpose, from an experienced farmer, who has practised it with success. The moss should be thrown out, and lie in long narrow heaps, exposed to the weather during the winter before it is used: the lime new from the kiln, should be quickly slacked and reduced to a mild powder: the moss should be pretty moist, its parts well divided, and carefully mixed; five parts, with one of lime, making both ingredients come as much as possible in contact with each other. The heap may be accurately turned, and any clots of peat separated, in two or three days, that new surfaces may meet, before the lime become effete; and then it should be sheltered from the drought, by a slight covering of wet litter or green weeds. Soon after, a gentle heat will take place, and continue for 8 or 10 days. Any time after, the compost is fit for lifting; and 50 cart loads per acre, will be a good and lasting manure for all thin hard soils.

Dung is mixed with surface earth in a manner similar to that in which lime is used. The dung is taken as recent as possible from the lodgements of domestic animals, and mixed with a greater or a less proportion of earth as the husbandman judges proper for his purpose. In such composts, the earth receives both the juices, and the gaseous products of fermenting dung; and thus the waste of fermentation is prevented, and a large increase of mould, well adapted to nourish vegetables, is added to the soil on which it is laid. But the compost by which the greatest addition of vegetable food is administered, is that of fermenting peat-moss with a mixture of new farm dung. This has long been practised less or more, and in various modes, by farmers residing near peat-mosses. Some have strewed dried peat-dust in the stalls of their live stock, to absorb the urine; and carried it afterwards, along with the dung, to the dung-stead. Some have laid a thick layer in the bottom of the dung-stead, to receive the juices of the dung to be laid upon it when carried from the stalls, and mixed thinner layers afterwards; and some have carried new dung to the field, and there mixed it with moss. But Lord Meadowbank, who applied, with scientific attention, to the making and application of this compost, and generously communicated the whole, was the first who taught the public to execute this in an accurate and masterly manner. The rules to be followed being now generally known, and successfully practised in different districts, need not here be repeated.

Composts, where both lime and dung are mingled with the earths, serve the purposes of both the separate mixtures. It has been very properly recommended, as mentioned in Sect. II., to incorporate the earth with the lime, before the dung be added. In this manner, the particles of the earths, separated by turning and mixing with the lime, receive, more regularly, the juice and gases of fermenting dung; and both a well constructed soil and a store of vegetable food are added at once. In all earthy composts, it is a good general rule, that the earth should differ as much in consistence from the soil on which it is to be laid as possible.

SECT. IV.

Concluding Observations.

These various substances which we have been considering as manures, are applied, by human industry, to increase or keep alive the fertility of the soil; without which, experience instructs us, a comparative sterility would reign. The two chief purposes for which they are applied, are, 1st, For giving the soil the proper consistence for holding the roots of plants, and for receiving, containing, and distributing the fit proportion of water for conveying food to them; 2d, For storing the soil with substances which yield that food. Fossil substances seem to be intended almost solely for the first of these purposes; unless fossils contain the solution of organized bodies locked up within them, little of which has hitherto been discovered. The burden of supplying with food, sufficient to bring to a profitable maturity, the plants cultivated by man, falls principally on the store of organized matter, in a soluble state, which he can administer to the soil. But when we consider the immense number of animals which have been nourished by the produce of the field, and are buried deep in the earth, or overwhelmed in the ocean—the vast quantity of the principles of which vegetables have been formed become insoluble in timber, coal mines, &c.—the no less quantity of animal and vegetable spoils which we see, every day washed away in torrents, and hurried to the sea—the great proportion of what has formed parts of vegetables, continually escaping in invisible gas, and mounting to superior regions, we are struck with admiration that fertility has not long ere now ceased; and are ready to conclude, that *the earth must wax old as a garment*, and the sources of fertility be at length exhausted. Lord Kames seems, long ago, to have been struck with the same alarming prospect. After stating the great quantities of provisions exported from countries, to which no part returns,—'It is,' he says, 'a puzzling question, Whence proceeds such 'a quantity of matter? for a new creation cannot be admitted. 'A perpetual effect must have a perpetual cause. The soil must 'receive without end what is taken away without end.' But those elements of vegetables, which, to our limited comprehension, appear to be lost, are still in reserve. The most durable compounds, by the irresistible power of time, are forced to yield to decomposition,—the bowels of the earth and the depths of the ocean are compelled, gradually and silently, to regorge into the atmosphere—and the atmosphere to the plants of the field, the leaves of which are extended to receive the celestial aliment. And, by this grand and simple machinery of concentric circles, of from one year to thousands, Infinite Wisdom and Beneficence has appointed the principles which have formed vegetables still to return again to their former station: and thus the powers of fertility continue undiminished. But the blessing most copiously falls on those who are wisely employed in preparing for its reception. The individual, or the people, by whose industry the soil is best adapted to its functions, and best stored with such soluble organized substances as are at command, will raise plants with the broadest, most numerous, and most vigorous leaves; and these will inhale the greatest proportion of aliment from the atmosphere. Thus, Nature is the willing handmaid of Art; and Industry the channel through which fertility must ever flow.

But a judicious discrimination in the application of agricultural industry, is highly requisite, in all its branches, and particularly in the one under consideration. The agriculturist, whose whole application was made for mending the consistence of a soil, destitute of vegetable aliment, would find his industry poorly rewarded. Nor would he who, regardless of the consistence and construction of the soil, attended only to the pouring of vegetable aliment into it, be at all times much more fortunate. We shall therefore conclude with submitting a few remarks on the applications proper to be made in different circumstances.

And, first, with regard to amending the construction and consistence of the soil, the two greatest and most obvious faults of which are an excess of density and cohesion on the one hand, and of porosity and want of compactness on the other. Nature has so greatly diversified the proportions and modifications of the substances of which the surface of our globe is composed, and so variously mingled them together, as to stamp neighbouring spaces with the most opposite qualities of friability and cohesion, and every different shade, from voluntary fertility to almost absolute barrenness, that it is not to be expected the industry of man can so fully overcome the predominant faults of different soils, as to reduce them to one standard of fertile disposition. But it is wonderful what change towards this disposition is produced by overturning and mixing masses of the earths, which have lain in different situations together; and it appears that, in all cafes, the extremes may be palliated: for though fertility, fo far as a mixture of the earths is concerned, lies between the extremes of cohefion and porofity, it is not confined to the ftrict medium; foils equally fertile, though for different purpofes, and requiring different treatment, being found at confiderable diftances on either fide: and there is perhaps no fpot, on which there is any thing like foil to work upon, which may not be rendered more productive, either of corn or grafs, by judicious applications.

The applications which have been recommended for the correction of too great cohefion, are, lime, fand, fea-fhells, burnt earth, compoft of peat-mofs. Shell marl was long thought a manure better fuited to open than to denfe foils, and has been moft frequently applied to the former.

Marl sand,
And you'll buy land;
Marl clay,
And you'll cast your labour away,

fays the old proverbial rhyme. But, from the effect which repeated marling has had of making open foils ftill more porous and open, the fame might be expected to make denfe foils friable; but there is no teftimony to that purpofe. One of the effects attributed to lime as a manure, is that of feparating the particles of cohefive foils. This is not an eafy tafk. The ftrict adhefion which holds the particles of clay together, refifts the intervention of other fubftances, and the comparative fpecific levity of this earth makes it rife over heavier fubftances. The practice of reducing fuch ground to a fine mould, by fallowing in the drought of fummer, before the lime be applied, is therefore peculiarly proper for this purpofe. The lime, in powder, fhould then be fpread and intimately mixed with the foil, if poffible, before rain come; and a moderate quantity at a time, and the operation repeated, is evidently preferable to applying the whole at once, for effecting the purpofe in queftion. Sand being of a quality directly oppofite to clay, is well adapted to anfwer the fame purpofe; and can be beft mixed in the fame manner. But though lime and fand operate fome degree of friability on clay, when feparately applied, their united effect is much more powerful. No thing has been found to improve the confiftence of hard thin foils more than the old mortar of ruined buildings. This might be well imitated, by flacking lime with foul putrid water, or the juice of a dunghill, and mixing it with fix or feven times its bulk of fand or friable earth, and keeping the mixture for ſome months ſheltered from the ſun and rain. Sea-ſhells, as they moulder in the ſoil, will no doubt operate as lime.

When the moſt coheſive earth has been ſubmitted to a red heat, and reduced to powder, its coheſive quality is annihilated, and its particles lye compact, without coaleſcing with one another. It then poſſeſſes the requiſites of a well conſtructed foil itſelf, and communicates, in ſome degree, that quality to the coheſive with which it is mixed. Valuable as this ſubſtance is, it is procured at too great an expenſe, by the waſte of vegetable matter occaſioned by paring and burning. Were its value more generally known, more ingenuity and induſtry would be exerciſed to procure it in abundance without ſuch waſte. It does not appear to be impracticable to have ſome kind of kilns or ovens conſtructed, which, if kept always hot, would burn a great deal with little fuel. By erections of this kind, on farms of an obdurate cohesive soil, the most sterile fossil clay might be burnt, and, by repeated applications of it, the stiffest soil might be converted into friable mould.

Composts of peat moss are valuable applications on cohesive soils, not only for keeping the parts separate while they remain unconsumed; but by furnishing a regular supply of vegetable food to the crops. By repeated applications of these composts, therefore, such soils may always be preserved in some degree of friability.

It is hoped it will not be thought foreign to the subject, here to observe, that water being the agent by which the particles of clay are made to coalesce, keeping clayey soils well defended from the operation of this agent, has a tendency to preserve them in some degree of friability. For which purpose, these soils should be formed in convex ridges of a moderate breadth, with furrows kept clear betwixt them, that the water falling in rains may quickly flow away, without lodging in the soil.

Soils, porous and open in a faulty degree, are of two kinds: silicious soils, the great fault of which is their inability to hold water for the support of vegetation; and soils, the particles of which seem to possess a kind of repellent force by which they recede from, and again approach one another, as actuated by the vicissitudes of the weather, and hence never furnishing a proper hold to the roots of plants. The faults of these two, differing from each other, required different correctives. Silicious soils lie compact, unless disturbed by the violence of foreign agents; and to correct the faults of such, it is only necessary to fill the interstices between the particles. Clay is the most proper subject for this purpose; but clay adhering in clods cannot be mechanically mixed with sand, so completely, as sand can with clay; and, while it continues in clods, cannot alter the consistence of the sand with which it is surrounded. It succeeds better, when spread on the surface, to lie till it be separated by the influence of the weather, and washed into the soil by the rain.

Lime holds more water than sand, though less than clay, and, as standing in a medium betwixt the two, might assist as a corrective, if used in a moderate quantity. A mixture of lime may thus be incorporated with the clay intended to mend the consistence of a sandy soil, and this mixture would mingle more intimately with sand, and prove an excellent corrective. Clay or stone marl, spread on the surface, would have a similar effect. Even a moderate dressing of shell marl would be highly beneficial for this purpose.

The fault of the other species of porous soils proceeds either from their containing an excess of the orange oxid of iron, or from their being principally formed of the earth of decayed *musci*, as has been shown in Sect I. In Sect. III. the application of quick lime is prescribed as a remedy for the disease occasioned by excess of the oxid; and burnt clay, which is recommended as a corrective of cohesive soils, from its disposition of lying always compact, is no less proper for counteracting the flatulency of porous soils. Its effects, wherever it is applied, and especially on mossy soils, is really surprising, and highly deserving public attention. But there is frequently found, on or near the surface, a dense earth, which, from its red colour, shows that it is strongly impregnated with the red oxid of iron, which is a good natural corrective. Where this can be had, a thick coat of it, spread and left to moulder on the surface of these porous soils, will prove a great and durable improvement.

Besides that of being an ingredient in the soil, proper to improve its consistence, other properties have been attributed to calcareous earth, both in a quick and effete state, for which it may be sufficient to refer the reader to what is said on that subject, Sect. III., till such time as the properties of this earth as a promoter of fertility be better known. It shall only be added, that wherever the practice is, to have arable land alternately in grass and tillage crops, it will generally be most advantageous to spread the lime in powder on the surface; especially if it be allowed to lie, for at least one season, in that state; and that where its quality, as quick lime, is not absolutely necessary, it will be more advantageous to have it mixed up with some kind of mould, than applied alone, making the mould of an opposite consistence to the soil on which it is laid.

The other great object of applying manure to the soil is, as above stated, that of storing it with food sufficient for the nourishment of the vegetables to be cultivated upon it: and this, it has been observed, is derived from decayed organized bodies. Some of these are possessed of peculiarities, on which various remarks have been made, in the preceding Section, by which some judgment may be formed of the proper mode of using them for manure. But Farm Dung, the most important article, may still require some farther consideration. In the last Section, a number of aphorisms were submitted to the examination of the public.

If these are admitted to be founded in truth, they may serve to correct some erroneous opinions held concerning this substance, and to direct how it may be most advantageously prepared and applied. From the doctrine contained in these aphorisms, we learn, that some of the component parts submit to putrefaction more quickly than others; and that those which are become putrid, when they come in contact with those still resisting, facilitate the putrefaction of the latter.—Hence all the ingredients should be mixed, and spread over one another in regular strata, so as to come in mutual contact.

That when the mixed ingredients are surrounded with putrid water, they gradually putrefy, dissolve, and are diffused in it, with little waste, and that putrefaction goes on without ceasing so long as they are kept moist.—Hence the mass should be so much compressed as not to leave vacuities among its parts; supplied with water sufficient to fill the smaller interstices; and kept level on the surface, that all parts may be equally wet.

That when putrefaction has commenced in these wet substances, surface mould facilitates the final decomposition, eagerly absorbs and retains the essence, allowing only the superfluous water to escape. This is proved by ocular inspection of soils which have been long and much dunged, where the stirred soil is of a dark colour, and what is immediately under it retains its original hue.—Hence there appears no necessity for continuing this substance under preparation, *till it be reduced to its first principles*, by which are lost the gases which escape in the preparation, and the gentle heat which the latter fermentation excites in the soil.

That when the substances in question, or their solution, are exposed to evaporation, water only escapes, leaving the substances essentially the same as before; but by long exposure to light and air, the undissolved part alters its colour, hardens, and becomes more difficult of solution.—Hence there is no cause for the apprehension which so generally prevails of dung being robbed, by evaporation, of its essence, its oils, its salts, and all these fine things; but nevertheless it is prudent to turn it, with all its moisture about it, quickly into the soil, and not suffer it to remain in a situation in which its solubility is injured.

Upon the whole, from any thing yet known, it appears that farm dung is most economically prepared by being macerated in a wet dung-stead, and may be safely carried to the field at any period, when the land is in order for having it quickly ploughed in. But if there should still be a necessity for carrying it out at any other period, a quantity of mould should be provided, with part of which a base should be formed of at least 8 or 9 inches thick on which to build the heap of dung; and as soon as the heap is finished, the rest should be clapped around and over it of equal thickness: Where peat moss is at command, it is very proper for this purpose. In this manner, though the bulk will be diminished, a good part of the essence will be preserved, Before quitting this topic, it is hoped it will not be thought impertinent again to recommend the regular spreading and careful division of the clots of dung, so that the soil and the manure may come more in mutual contact. The difference of effect between this and the clumsy manner in which the same business is sometimes performed, will be found not less than a tenth of the whole, and well worth the attention of every prudent husbandman: nor is it less worthy of attention, to plough in manure with an ebb furrow, so as to be near the surface, within reach of the temperature of the atmosphere and the roots of plants.

Well digested earthy composts may be exposed on the surface with still greater safety, than town dung. The organized substances being decomposed, and the solution absorbed by the earths, it is retained there in readiness for the nourishment of plants, wherever it is applied. These composts are therefore well suited for spreading on the surface, to promote the growth of the present crop, commonly called top-dressing; and will be found beneficial for that purpose, wherever the practice is convenient or practicable. They are with equal propriety spread on the surface of pasture grounds, and either promote the growth of herbage, or of corn crops, when ploughed in: and they have the additional advantage, that they somewhat increase the thickness of thin soils.

Among the various purposes for which the earths or earthy composts may be successfully applied, is that of amending the construction of barren soils. Thin, ill constructed soils, on an impervious bottom, are more permanently amended by a close covering lying over the surface, than by the most operose exercise of the plough. By the former the soil is thickened, an increased growth of herbage is excited, the soil is defended from the storm, the subterraneous heat is retained, and a mellowness is gradually operated, which, under good husbandry afterwards, will long continue. Whereas, after mechanical pulverization, the particles of such soils often coalesce more firmly than before. Hence it may sometimes be prudent to resort to the influences of Nature in aid of human industry.

Hitherto the consistence of the soil only has been adverted to; but, for the purpose of abundant vegetation, it is requisite that it be of the same consistence for a sufficient depth, not only to give ample range to the roots of cultivated plants, but to retain a sufficient store of water in a proper state for supporting them, in a dry time, and allowing the excess to pass downwards in a wet time. When the soil is thin, and the bottom so impervious as neither to suffer water to rise in exhalation during the scorching drought of summer, nor to descend in great rains, the crop is apt to suffer from the one extreme or the other, and is seldom plentiful. Even where Nature has been bountiful in giving ample depth to the soil, if that gift has been long despised, and the surface stirred only with a superficial scraping, the unstirred earth below will consolidate, and the defect of a thin soil on an impervious bottom will, in some degree, be experienced. To preserve a sufficient depth of soil is, therefore, in all cases, of vast importance, and has perhaps been too little attended to in the practice of modern husbandry. Much ingenuity has been employed to facilitate the execution of field labour; various forms of the plough, to operate with less resistance, have been constructed; and the work has been executed by the application of less power. This is no doubt a great step in improvement, when the purpose can be equally well attained. It is pleasant to see the ploughman conduct a pair of well trained horses to the field, and, in a masterly manner, perform the work which formerly required the aid of an awkward ploughboy, and a number of unwieldy animals: and when the implements are well constructed, the horses powerful, the soil pliant, the bottom not obdurate, and the ploughman intelligent and dexterous, this, no doubt, may be done. But the passion for imitation is strong; fashion overrules judgment; and two feeble animals, ill appointed, are expected to perform what is task sufficient for the most powerful—the surface is slightly scratched—attention to preserve the depth of the soil disregarded—and the progress of fertility retarded.* It would seem proper, therefore, to pay a due regard to this important branch of Agriculture, and employ power adequate to the resistance, so as to stir the ground to such a depth as a healthy vegetation requires. This, however, is peculiarly necessary where a thin soil on a dense bottom is to be improved. The soil should be turned over to the bottom, and a part of the hard subsoil along with it. When this sterile substance is mellowed in the air, a good dose of earthy compost, mixed with it, will give it the property of a fertile soil, and, by increasing the depth, will prove a greater and more durable improvement, than additions on the surface alone.

There are thin soils, lying on bottoms faulty in the opposite extreme, which may be improved in the same manner. When the soil has, immediately under it, a bed of sand and gravel which cannot retain water, the crop upon it soon sickens in the summer's drought. By turning up a part of this porous matter, and mixing it with compost formed of tenacious earth, the soil would be made more retentive of water, and the defect greatly palliated.†

* This stricture perhaps is not popular; but, it is to be feared, it is not the less just. There are people living who remember fields, formerly ploughed to a great depth, by the joint force of horses and oxen, and bearing large crops, which now, scratched by two sorry jades, yield very scanty ones. Other symptoms might be stated, and much more said to the same purpose; but it may be thought a digression to enlarge on articles the subject of a prior chapter.

† When the soil is of a favourable construction to a sufficient depth, there will be no need for mixing earthy matters with the manure. Heterogeneous mixtures of unconsumable matter are apt to excite an undue porosity, and form

Composts of peat moss differ greatly from those of which some kind of mould is the principal ingredient. The vegetables of which this substance is composed, are the most durable of all the minute tribes of the vegetable kingdom; and the mass formed by them, still remaining undiminished, was long regarded as incorruptible, an unsightly load, overwhelming much of the surface of the country, and almost useless, except for the fuel that was cut from it. But in later times, it has been discovered that, notwithstanding its resistance, fermentation may be excited in it, by the arts of human industry, and decomposition be accomplished; so that, like other vegetable substances, its principles may again revive in a new vegetation. This has now been ascertained by numerous experiments, on a large scale, in different parts of the country; † whereby it has not only been made productive of plentiful crops of cultivated vegetables, on its native field, but had the same effect when used as a manure to others. Instructed by these successful experiments, we now see that the turbaries, interspersed over the face of the country, are a great fund of fertility, which nature has stored up, in a barbarous age when the people were few, ignorant and inactive, to support the numerous, active, and industrious population of a more enlightened period. It becomes, therefore, the enterprizing husbandmen of the present times, to avail themselves of this gift of Providence, by converting this torpid substance into valuable manure, wherever it is accessible. As rules for preparing this manure are known, and the practice of using it become pretty general, it shall only be added here, that as the agents employed to excite fermentation on this substance, act more powerfully the more its parts are separated, the moss which is best adapted to the purpose, is such as is friable, and falls easily asunder. But pure peat-moss undecayed, is held firmly together, as well by the filaments of the plants, as by a kind of viscidity of which it is possessed. If, therefore, there be no other at command, it should be loosely laid up in thin heaps, exposed to the weather, and lie as long as convenience will admit: and the lower parts, as being less fibrous, are preferable to those nearer the surface.

Finally, preparations from decayed organized bodies being not only the sole subject, within the reach of human power, by which direct aliment to cultivated plants can be conveyed, but also, by repeated applications, a powerful corrective of the

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lodgements to the noxious insects, by which the young crops are frequently injured. The manure, rendered soluble by maceration in the dung-stead, will be best applied alone; and a moderate quantity, accurately spread, and repeated at short intervals, will be preferable to a great load at a time.

† For a full account of successful improvements made on peat mosses, Mr Aiton's treatise on Moss may be consulted (Ayr, printed 1811), page 314, et seq.

faults of soils both of a dense and porous quality, it is of the greatest importance to the husbandman to have this subject at command, in such abundance as to produce the desired effect on every field, in course, on which he finds it convenient to operate. Alternate courses of plants of a different character, that is to say, of culmiferous and leguminous plants, commonly called white and green crops, regularly succeeding each other from year to year, and of tillage and grass crops, succeeding each other, commonly called convertible husbandry, an economy very generally adopted in Scotland, is well calculated for this purpose. It was a very antient maxim among the cultivators of land in Scotland, though it has frequently been ill observed,

Sow peas and corn year about,
And you'll never run land out.

An economy upon this principle has, however, of late, been reduced to a regular system in some districts, where the climate is most favourable, the soil happily constructed, and the cultivators active and intelligent. By a strict attention to keeping the ground free of all kinds of weeds, and the injurious effects of stagnant water—by preserving the friability of the soil by the repeated exercise of the plough and harrow—by the intervention of a broad-leafed crop, which overshadows the surface, and draws much sustenance from the atmosphere, between two culmiferous crops, which depend more on the soil for their support—by making the greatest possible quantity of manure from live stock carefully tended and fed—and by carefully economizing this manure, so as to give every field its share in due rotation, the soil has been preserved in a state of undiminished productiveness for a number of years, without scarcely ever resting in grass longer than one year at a time. If this productiveness can always be preserved by the same means—if the favourable consistence of the soil will not at length be deranged by incessant culture—if the same plants, naturally aliens of the country, will not become more liable to fatal diseases by being long repeated in quick successions on the same fields—or if the land will not become weary of producing them, are questions which time must answer.

But there is not a great breadth of the country so happily circumstanced. The quantity of manure which promotes a few plentiful crops on those fertile fields, would scarcely have any sensible effect on many others. The manure which, by the strictest economy, could be made from all the live stock which could be supported on less fertile land, would be inadequate to what plentiful crops would require, if the whole farm were constantly cropped. But, by putting one field after another in grass, before the soil be exhausted by cropping, it yields a return proportioned to its fertility, without expense, its herbage is attracting food from the atmosphere, and its powers are renovated. In the mean time, the extent of cultivated land being curtailed, the manure, for its supply, is more abundant, by which it is fitted to bear valuable crops, and yield better grass in its turn. This judicious system is very prevalent; and whoever blindly departs from it, without having the command of adventitious manure from organized matter, foolishly labours to his own loss. When the value of the crop does not exceed that of labour, seed, rent, &c. both the owner and the public suffer loss, at least, equal to what the same ground would have yielded in pasture: and whoever continues, injudiciously, to labour land, for a crop to which sufficient feeding manure has not been administered, to give rational expectation of a profitable one, not only hurts his own interest, but is the enemy of society. The effectual demand and money price of the produce of the dairy and the shambles, is not less than that for corn. The soil cannot produce advantageous crops of corn, without being duly stored with vegetable pabulum, which can only be administered to a certain proportion of the whole:—What is so treated, is qualified to produce more and better grass;—continued repetitions of animal and vegetable substances macerated in putrid water, and still imperfectly fermented, separate the parts of dense, and fill the interstices of porous soils;—and, in short, it appears that by the system of convertible husbandry, accommodated to circumstances, and by this system only, the general fertility of the country may be preserved and improved.

Chap. XII. App. Part 4. No. 2.

Plan for ascertaining the Effects of the different Sorts of Manures in promoting Vegetation.

By George Fordyce, M. D.

It is known from experiment, that plants will grow in sand and clay, with the addition of distilled water and atmospheric air; and that after the plant has grown, if it be taken out by the roots perfectly clean, that the sand and clay are exactly in the same quantity as before the vegetation of the plant.

The whole of the nourishment of the plant, growing thus in pure sand and clay, is therefore taken from the water, or the atmospheric air.

It is farther ascertained by experiment, that certain substances being added to the sand and clay, the plant will grow more luxuriantly in all its parts, than if it had grown in sand and clay alone; the water and the atmospheric air being the same.

Substances which, when added to sand and clay, occasion a plant to grow more luxuriantly in all or any of its parts, are called Manures.

Plants consist of roots, herbaceous stems and leaves, flowers, fruit, seeds. Certain substances added to sand and clay, are known by experience to make plants grow more luxuriantly, some in their roots, some in their herbaceous stems and leaves, some in their flowers, others in their fruit, and others in their seeds.

It is farther known by experience, that certain substances will have a very different effect in promoting the luxuriancy of plants when added to pure sand and clay, from the effect they will have when added to sand and clay with which other substances have been previously mixed. Or, in other words, one manure will assist another in producing luxuriancy in the growth of the whole, or any part of a plant.

If one species of manure produces no effect when applied to a mixture of sand and clay, unless another manure has been previously, or afterwards, employed; and if the manure which it is necessary to employ previously or afterwards, produces an effect, whether the other had been employed or not, which effect is, however, greatly increased by the addition of that other manure, the effect of the one manure must be that of producing an alteration in the other manure, or some alteration in the plant, by which it may profit.*

All the experiments which have hitherto been made on the addition of manures to sand or clay, have been performed only in small pots, in such quantities as not to be at all applicable at large; or in some other manner, so that no certain conclusion can be drawn from them. All other experiments on manures, particularly those made by practical farmers, have always been upon sand and clay mixed with an unknown variety of other substances; and carried on without any attempt to investigate what these other matters were.

It is therefore proposed, that some effectual experiments should be made upon sand and clay, mixed together in such proportions as may be rendered rich soil. For this purpose, a field should be chosen, naturally consisting of such a mixture; known by experiment to be from one fifth of clay and four-fifths of sand, to half

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* A manure may be itself the food of plants, or it may be of a kind that will bring other manures to a state adapted to their digestive powers, or it may excite in the plants themselves an operation which may cause other manures to be digested, that otherwise would not have been so, or may render an imperfect digestion complete. A buttock of beef, for example, yields essential food for man; but if a man had neither knives and forks, nor teeth, nor any other mode of cutting it in pieces, it could not be swallowed, and, even if swallowed, it could not be digested in a weak stomach, unless pepper, or some other stimulant, were thrown in with it. Neither the knives and forks, the teeth, nor the pepper, give nourishment to a man; yet, without them, the beef, which gives the nourishment, could not be digested. Now, the question, with regard to manures, when different sorts are mixed together, is, which of them represent the buttock of beef, which of them the knives and forks, and teeth, and which of them the pepper? One principal object of the proposed experiments is to decide this point, which authors are by no means agreed about, although it be the foundation of agriculture.

he conceives it will be preferable, in this instance, to mix the manure with the soil before the seed is committed to the ground: the experiments may afterwards be varied, or they might be tried in different manners upon the remaining parts of the field.

3d div. The dung of animals not putrefied, such as cow-dung, which might be procured recent in sufficient quantity.

4th div. Vegetable substances not putrefied. The dung of graminivorous animals consists, in fact, of vegetable substances, having gone through the operations that take place upon food in the intestines of the animals, but not putrefied.

5th div. Animal substances rendered soluble in water, but not in the least putrefied.

6th div. Animal substances rendered putrid, such as pieces of meat mashed down very minutely, and kept in a sufficient degree of heat to render them perfectly soluble in water. All the above animal and vegetable substances are nearly free from any saline matter; and therefore, in the first experiment, such animal or putrescent substances may be neglected as contain saline matter, such as the dung of pigeons, sheep, &c.; because in primary experiments the effects should be taken separately as much as possible: Afterwards, their conjunct effects may be made out by subsequent experiments.

The next class of manures is saline substances; of those, neutral salts are the first that should be tried. Of the great number of these, all of which may differ from one another, it will only be necessary to try one at first; and he would propose—

7th div. Sea salt, which ought to be rendered quite pure. Of the second class of salts, earthy salts.

8th div. Epsom salt, the substance contained in sea water and in the residuum of sea water, after the sea salt has been separated from it.

Other earths than sand and clay may fertilize the soil; but in the primitive experiments it may be sufficient to try calcareous earth in its two states.

9th div. Pure calcareous earth, or lime.

10th div. Calcareous earth, combined with gas or fixed air.

11th div. The last division should be of the natural earth only; but with this difference from the first, that the plants here should be constantly watered when the weather is dry.

All these applications should be equally applied, according to the manner above described, upon the acre on which the soil of the other acre has been laid.

If a field were procured of five or six acres, Dr Fordyce would also wish the sand and clay of a quarter of an acre to be cleared of cultivated soil, which should be laid upon another quarter of an acre, in order to try upon both the comparative effects of irrigation, or watering, upon the sand and clay alone; and upon the soil already containing animal and vegetable matters.

CHAP. XII. APP. PART 4, No. 2. *continued.*

Plan of the Field, as proposed to be laid out for Experiments on Vegetation.

Wheat.	Oats.	Peas.	Potatoes.	Parsnips or Carrots.	Turnips.	Gramina.	Legumina.

CHAP. XII. APP. PART 6.

No. I. OF IRRIGATION.

SECT. I. *On Wears and Dams, and Flood-Hatches or Sluices.*

One or other of these are commonly wanted in irrigation. If the stream be small, (of only 2 or 3 feet wide), then a dam may be made with a few *sods* or turf, which will be sufficient; but if the stream be 2 or 3 yards wide, and abundance of fall to the meadow, then a dam of sods will likewise do; but it must be covered over with stones like an arch, otherwise, in floods, the water will drive it away. If stones cannot be got, then a piece of wood may be laid across the stream; and piles or stakes drove into the bottom of the water above the piece of wood, which, resting against it, will prevent the water from carrying away the dam made above, and resting on, the stakes. If the water be a large river, and it be all wanted to be diverted, the wear must be made of dressed stone, and well puddled at the back with stiff clay; or if it be wanted sometimes to let the water down the channel, sluices or hatches in frame work, will answer best. To describe these large species of flood-hatches would be tedious, and perhaps useless, as no person who is not acquainted with them, could execute them to answer the purpose. The kind of wears used for taking in water to the mills in the North of Scotland, built with rough stones, will do, where you have declivity enough, without raising the stream above 1½ or 2 feet, as sluices or hatches are sometimes wanted for the feeders and conductors.

SECT. II. *On the Formation of Floated Meadows.*

The rules already given (see Chap. 12. Part 6.), being attended to, and the water carried with a proper fall* to the highest part of the meadow, (for it should never be upon a dead level if it can be avoided); the next object is, to make the conductor or feeder large enough to receive all the water that the stream contains, if there is land enough to use it. If there is a great fall from the wear or dam, to where the meadow is to begin, it may be made the deeper and narrower; but if it is nearly level, it must be made the shallower and wider, as it is only near the top of the stream that the water has any draught. It is of no use to make the bottom of the conductor deeper than the feeder will

* A proper fall is, from one inch of fall in 20 yards, to one in 30, according to the weight and velocity of the water above the mouth of the conductor.

draw the water out of it; neither is it of any use to make the bottom of the feeder any deeper than the last floating gutter will draw it off. It is best to make the conductor straight from the dam to the meadow, if it can be done; if it passes through any hollow, the sides must be raised to keep the water up to its level; but sweeping round by the edge of a hill or bank, will, in general be found the best method in the North of Scotland, and in all other hilly countries. In forming the master-feeder, it will be necessary to ascertain the breadth and depth that will hold all the water that the conductor brings to it, and thence to the end of the feeder, where the last floating gutter goes out. Its breadth should be diminished all the way; and, whatever its breadth may be at the beginning, it should end about 2 feet in breadth where the last floating gutter goes off. If the ridges or beds be 10 or 12 yards wide, and about 100 yards long, with 6 or 8 inches of fall, the breadth of the floating gutters should be about 18 inches at the head, or 2 feet, according to the length of the gutter; and about 6 inches at the lower end of the ridge: This diminution of the gutter, serves to force the water out over the sides of the beds; and as a part of the water is always going out of the gutter, it is always growing less, and consequently does not require so much room to hold it. The stuff that is taken out of the feeder, should be laid smoothly upon its sides, with a slope outwardly, and raised about 6 inches above the surface of the ground; and in crossing ridges, the hollows must be filled up with superfluous stuff from high places, or out of the drains, so that the top of the banks of the feeder may represent a straight horizontal line. † In making the floating-gutters, after both sides of it are cut with a spade, by a line, then cut again with a spade down the inside of your lines on both sides, beginning at the head, about 5 or 6 inches from your line; so diminishing all the way down to the end, and pointing the edge of your spade, so as to make it intersect your outside cut. When both sides are done, the land in the breadth of the gutter will be divided into three strips, the outsides of which will be loose, and will turn out whole in triangular furrows, which form the sides of the gutters, and keep up the water above the surface of the ground. After the sides are cut, there will remain a fast strip in the middle, which must be taken out and laid in equal portions on the outsides of the foresaid furrows, or into the lowest places. In taking out the fast strip, it is best to leave here and there a piece unremoved, which serves for stops, and saves putting in afterwards; and if you leave too many, it is quite easy to take out some of them, as it is always better to have to take out than to put in. These

† This raising of the banks keeps up the water above the surface of the ground, which is always necessary to make it flow down and over the sides of the floating gutters with proper effect.

stops will be wanted more or fewer in number, according as there is much or little descent in the floating gutters: indeed, I have always found it best to leave some fast places both in the feeders and gutters, where there is descent to require them. These portions of fast land left, may be about one foot thick in the gutters, but in the feeder stronger, from two to three feet thick, according to the size of the feeder. When there is nothing left in for stops as above, the defect must be supplied by driving in stakes in the feeder, and putting in boards or sods before them, to check and raise the water to the height you want it; also sods must be put into the floating gutters for the same purpose. Without stops, the water would all flow to the lowest end of your work, and there run out too deep, while the higher parts of the meadow would remain dry. Notches are commonly used, at first, in letting out the water from the feeders and gutters over the beds; but when the sides become older and firmer, it may be made to flow over them. The breadth of the beds, to be right, should not exceed 10 or 12 yards, or even 8 would be still better, if the piece of ground floated be small, and abundance of water at command; but 12 is a very good size. However, as the most part of the land that lies within reach of water in the North of Scotland hath been formerly ploughed, and left in ridges raised from a foot to eighteen inches high, you have no alternative but to take the breadth of the ridges as they are, which should always be done if it is old swarded grass, and the ridges tolerably regular, and not less than 8 or 10 yards wide; but if they are less than 8 yards wide, it is best, in general, to put two into one, either with the spade or the plough. The length of a division of floating gutters should never exceed about 100 yards in the ridges or beds; because, if they are too long, it makes the water more intricate to size; and, if the stream be fluctuating when the water falls in, the upper parts of the beds will be dry. Indeed, sometimes the ridges or pieces to be floated do not exceed 110 or 120 yards in length altogether; in that case, it would be rather too short to cut into two lengths: But when the ridge or land is 180 or 200 yards long, (or a few more or less), it is always best to cut it into two lengths, and if much longer, into three; and so on, if they are more. If the ridges are less than 100 yards long, take them as they are; there is no matter. All floating is the better of a descent, from the crown of the ridge to the furrow, of from one inch in a yard, to two inches. This must be attended to if the land is to be formed into beds with the spade or the plough; but where it is in proper ridges before, they may be taken as they are, be the descent less or greater than as above. If the land be plain ground, the stuff that is taken out of the drains must be laid at the back of the floating gutters; which, in time, with the cleanings of the gutters and manure deposited by the water, raises even flat ground in the shape of ridges. At the end of the meadow, and indeed at the end of every set of beds, there must be a drain (equal to the size of the feeder that supplies the gutters in the beds with water), which must carry it off into a master drain, or immediately into the river; and betwixt every two gutters there must be a small drain to receive the water that flows over the beds, and carry it into the cross or main drain; only these drains should be begun quite narrow at the upper end of the beds, and increased all the way down to receive the increase of water flowing from the floating gutters. These small drains must be parallel with, and reverse in their dimensions to, the floating gutters; least at the upper, and largest at the lower end: whereas the gutters are largest at the upper end, and smallest at the lower. These small drains, if in a dry soil, will do 6 inches wide at the head, and 18 inches * at the foot of the ridges. The stuff that is taken out of them, is always wanted to make up hollows, or to make up the banks of the feeders to carry them through low places to higher ground; but wherever it is put, it must be properly smoothed, to let the water flow regularly over it. When a meadow is large, and the surface not all upon one section, but has high and low places in it, more feeders must be made, and more cross or master drains. Sometimes it happens, that a feeder must cross a drain in carrying the water from one eminence to another through a hollow: In this case a trunk must be made with boards of the size of your drain, and placed in it, and the feeder carried over it. Your trunk must be as much longer than the width of the feeder, as will be sufficient to give room for proper banks to your feeder, otherwise the weight of the water will force them out. If the feeder be small, and the drain large, it will be cheaper to make the trunk or spout correspond with the size of the feeder, and carry the water over the drain in it. Drains will always require to be deeper in cold, rushy, boggy, or spritty ground, than in dry soils. Hatches or sluices (one or more according to the size of the feeders) are always necessary in the mouths of them, for excluding or admitting the water at pleasure; and also for changing it when the meadow is divided into divisions.

All the foregoing observations will be better understood by consulting the plates, with their explanations.

It sometimes happens in the north of Scotland, and may frequently happen, that the land proposed to be converted into a water-meadow hath been ploughed the year before, and is left out in crooked, narrow, and irregular-sized ridges, but full of natural grass roots: In this case, it is best to plough it again, and make it into proper ridges, by first levelling it, and then straightening the ridges, and gathering them up; so that the crown may

* Or two feet, according to the length of the drain.

be as many inches higher than the edge of the ridge at the furrow, as the half of the bed is yards wide. This may be better understood by consulting Plate I., with the section, Fig. 2.

The ground so ploughed must not be harrowed much, and as little of the natural grass taken out of it as possible; for natural grass stands the water better than artificial; and the more grass there is left in it, the less will be wanted to be sown. Perennial rye-grass, the shakings of natural-grass hay, rib-grass, and the like, may be sown to produce grass at the first; and afterwards the water will raise grass of itself. The water may be admitted (but with caution) in one year after it is done, if the land be firm, and plenty of grass-roots; but two years after is better; and it is best always to do it late in the spring, as it then grows against autumn, and is in no danger of being swept off with floods, even though subject to be overflowed.

The water, in floating a meadow, should be made to flow over the beds about one inch deep, if the descent from the gutter to the drain be one inch in a yard; but if the descent be greater, the same quantity of water will appear rather too little in depth. Less water than this is not strong enough to carry a sufficient quantity of manure or sediment over the surface of the ground, and to shelter the grass; if much more than that quantity be used, it hurts the grass, by keeping the air from it.

All the w[illegible] that I have seen used for floating here, in the North, deposits more or less of light manure on the surface of the meadows, particularly in going over the ground the first time; but no water is so good after it hath been used two or three times, as when it comes first out of the river. Water should never be used above twice after it comes out of the stream, before it be returned into the channel again. But if it be again returned to the channel of the river, then the water recruits itself, by mud that may be deposited in the bed of the river, or by water that may pass by the meadow, which has not before been strained; and if this be not the case always, it is certainly so in rainy weather, which swells the stream, and makes it flow over the wears or dams, or over its sides, and so passes by. In floods, the water is always richest; and one good flood will deposit as much manure on a meadow in 24 hours, as a clear stream will do in two or three weeks; therefore autumn flood ought always to be turned over the meadows if possible. If it be wanted to make several floated meadows in succession down the sides of a river, the water should never be used above twice without returning it again to the channel of the river. Th[illegible] perhaps may increase the expense, by causing more wears or dams, &c.; but the advantage of getting a part of the wat[illegible] in its original state, particularly in floods, will amply repay th[illegible] difference. I have always found that water, used more th[illegible] twice, without being again recruited as above, does but ve[illegible] little good. Having seen this so clearly demonstrated by my own experience on a floated meadow in England, I have never tried it in the North of Scotland, unless in some trifling instances; and I have still observed the effects to be the same. If water be used after once or twice straining over the land, the meadows should be so much circumscribed as to make the water that went over the first meadow at three times, to go over the second at twice, and so on, always observing to use quantity of water for quality; for the poorer the water is, the more weeks it will require to be on the ground. Again, if a stream be rich, the less time will do in a season at a time; but when the water is turned again into the bed of the river, and taken out again a little space below the first meadow, then the water used as above on the second, will shelter the grass in ordinary times of water, and in floods it will enrich the land. I have been the more particular on the above part of the subject, because I know that inattention to this circumstance has been productive of great deceptions, and sometimes has hurt the credit of Irrigation.

As the succeeding plates are designed for information to the North of Scotland, they are adapted to the position of the subjects fit for irrigation there: Of which it may be observed, *1st*, that most of the haugh or meadow land there is lowest at the side next to the river; *2dly*, that the most of this kind of land is commonly highest in the middle of a haugh, *i. e.* between the river and the next brae; *3dly*, that very commonly there is a hollow on the side of the haugh or meadow opposite to the river, and betwixt a brae and the haugh. Now, as the ground rises from the river to the middle of the piece of land wanted to be floated, (as is generally the case here), it will be necessary to take the water out above the land wanted to be floated, in order to get it carried to the most elevated spot in your designed water-meadow. When a meadow is highest in the middle, and is long enough to be made into two divisions, the second feeder must be carried down the centre of it, to make the water fall off to right and left on the second divisions, as may be seen by Plate II. This second plate also shows the use of the hollow for cutting a main drain in, for carrying the water from that part of the meadow into the river again. As the ground rises from the river as above noticed, there is no danger of want of declivity for reconducting the water back again to the river in this country (if it can be got on), as is sometimes the case in England, in flat land; for there the ground is frequently highest at the edge of the river, which makes it necessary sometimes to carry the water a considerable distance below the end of the meadow, before a sufficient fall or descent can be got for again returning the water into the bed of the river. The case is just the reverse here in Scotland; for the water must be taken out above the meadow; and it will of course go in again at the end, or any part of it, without having recourse to a back-drain as above.

Chap. XII. App. Part 6.

No. II. Description of the Plates.

Plate I.

Fig. 1.—This represents part of a division of a water-meadow, containing three complete beds, of proper length and breadth, on a large scale of two inches for one Scotch chain of 24 ells. P M F, represent a part of a master feeder, in exact proportion to the three floating gutters it has to feed, with a solid earth stop left in it, marked s. The three floating gutters are marked 1, 2, 3; and they represent a floating gutter in three different forms or stages. The first is designed to show the four lines cut with the spade in making a new gutter, before the sides are turned out; the next, marked 2, is designed to represent the sides of a new floating gutter, after they are newly turned out; the next, marked 3, represents a floating gutter that has been some years made, in which the form of the banks has disappeared, and the breadth of the gutter only visible; the dots marked in the gutter represent stops, or portions of fast earth left for that purpose. All the small drains answering to the gutters are marked with a d, and the part of a master drain with P M D.

Fig. 2.—Represents the sections of the three beds above described, and are marked 1, 2, 3.

The 1st represents the form of a bed formed with a plough, before the gutter is turned out. The small dots at A, represent the section of the angular furrow, formed with the spade, as mentioned at page 131, before they are turned out.

The 2d shows the section of a proper bed, after the angular furrows are turned out on the sides of the floating gutter.

The 3d shows the section of an old bed and gutter, after the shape of the sides of the gutter have disappeared.

The 4th is a section of the feeder, with its back half bed.

Fig. 3.—Represents the simple mode of levelling mentioned in the chapter. A, the stream; B, the dam; C, shows a small notch or ditch in which the water stands dead level; d d, two sticks set up of equal height above the surface of the water; E, is the spot to which the water is wanted to be conducted, and to come out upon the surface; d, is another stick set into the ground, exactly the same height above its surface as the other two are above the water. Now, it is evident, from looking over the two sticks set in the water, that if you see over the

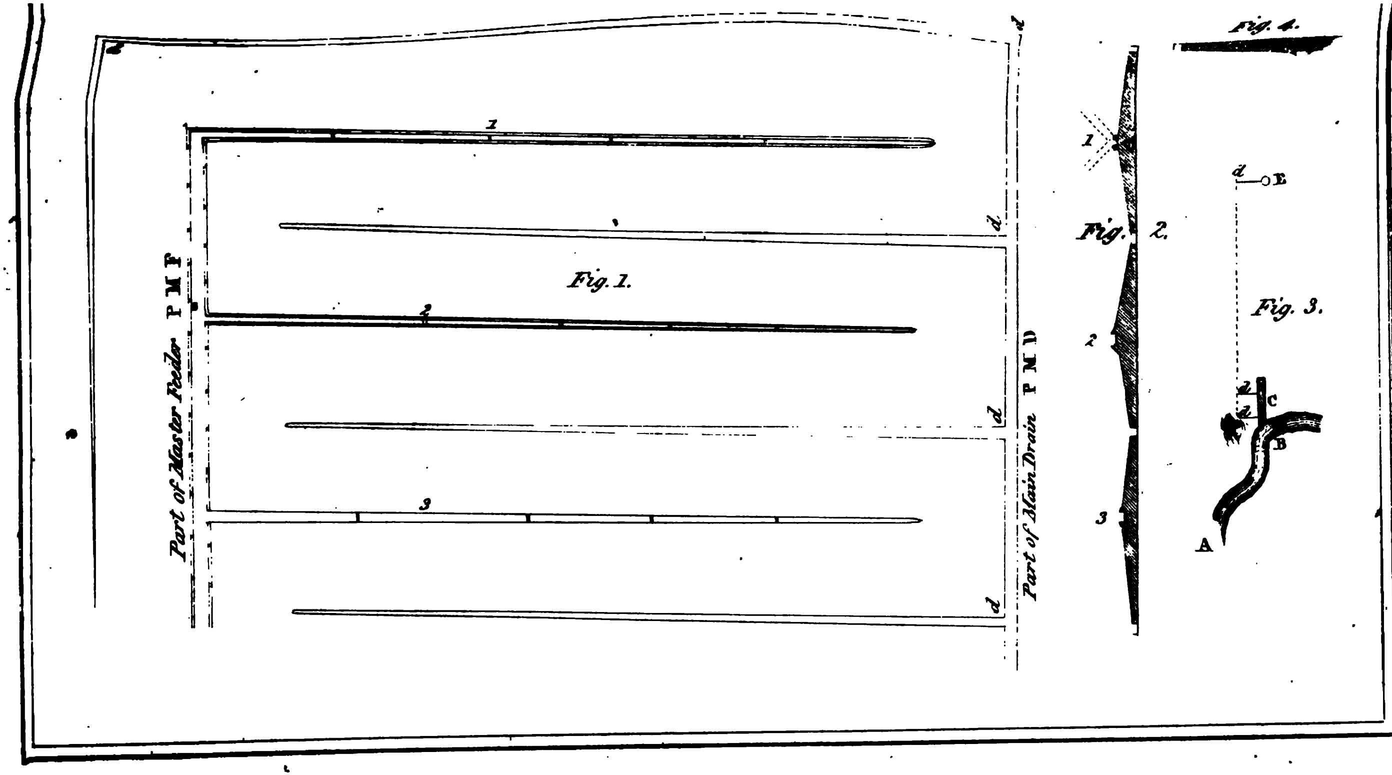
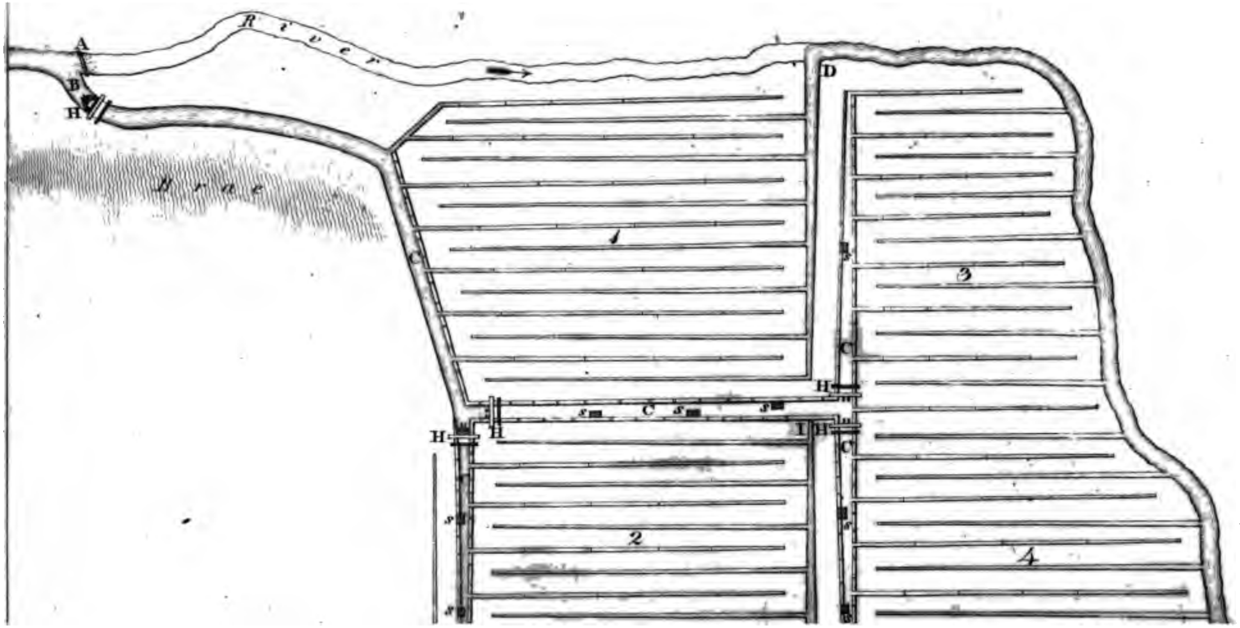


Fig. 1.
Part of Master Feeder P M F
Part of Main Drain P M D
Fig. 2.
Fig. 3.
Fig. 4.
A
B
C
E

IRRIGATION

PLATE II.



third stick, the water will go to the place desired. The above is so simple, that it will be easily understood by the figure, without any farther explanation.

PLATE II.

In this plate, I have attempted to delineate a regular formed flat water meadow, on the position of the haugh-land in Scotland, as mentioned at page 135. This piece of land is supposed to be in ridges, of from 10 to 12 yards, designed and formed so by the plough, or left so by accident, with a sufficient descent down it; but from the cause mentioned at page 135, it is supposed necessary to take the water out of the river above the meadow, as far up as the water might be raised with a low wear of stones, high enough to go to the most elevated part of the meadow. For this purpose, the place marked A, is found high enough, which is a rough stone wear of about 2 feet high, and is supposed to divert from the river all its water into the conductor B, in ordinary times. The conductor B is carried along the edge of a brae, to keep up the water to the level, until it enters the meadow, when it is laid out into a feeder, with a bank on the lowest side, to keep the water above the surface of the ground, so as to throw it with the more force into the floating gutters: The bank (and all the feeder banks) is described with a double line, with notches through it, for distributing the water: The distance betwixt the notches is not fixed, but variable at pleasure, and may be in one place one year, and different in another. The feeders are marked with a C in each branch, and each main drain is marked with a D, being 2 in number. The places, marked H, are hatches or sluices, for removing the water from one part of the meadow to the other. The places, marked with I, are small apertures for letting off any water that may remain in the feeder after the water is removed. The places marked with s, are stops for obstructing the water, and forcing it over the sides of the feeder, or out at the notches. The small dots in the floating gutters, are stops also for the same purpose.

This meadow is divided into four divisions, which are marked 1, 2, 3, 4. The river is supposed usually to afford water enough for two of these divisions at a time; and in floods, for all four of them: But in spring, when the water turns scarcer, or too little for two divisions, then one of them may be done at a time.

I have attempted to show the water upon, or in, the feeder of the first and second divisions. The hatch is supposed to be lifted up, in the mouth of the feeder that waters divisions 1st and 2d; and the other hatch down, that is, in the mouth of the feeder that waters divisions 3d and 4th. When this last hatch is lifted up, and the other let down, it is supposed that the fall in this middle feeder is great enough to draw the water in the head feeder below the mouths of the floating gutters; but if it does not, a sc or bit of board may be put into the mouths of them, to keep th bed perfectly dry, when the water is removed from one divisio to another, as above. A slab or deal is laid behind each of th hatches, marked on the plates with a deep, black stroke, th ——, as a bridge for the person to stand upon when the hatch are taken up or let down. It may be seen by the positions wh the hatches are placed in this meadow, that any part or parts it may be watered at a time, or the whole of it together. Th two sides of the above meadow are supposed to be wetter groun than the middle, and in that case the beds are made a little nar rower: which should always be the case, that the ground may b properly drained; for which purpose, in this meadow, the out side drain is made, or should be made, a little deeper than th others, to cut off any surrounding sink. The other small drain betwixt the gutters are supposed to be 6 inches wide at the head, and 18 or 20 inches at the foot.* This size of drains is sufficient on a piece of dry haugh of the above description.

N.B. The best water meadow that is in the power of good water, would be very unproductive (or perhaps made worse) if not properly drained, *i. e.* with drains, small and great, to answer to the feeder and gutters, as they are described on this plate.

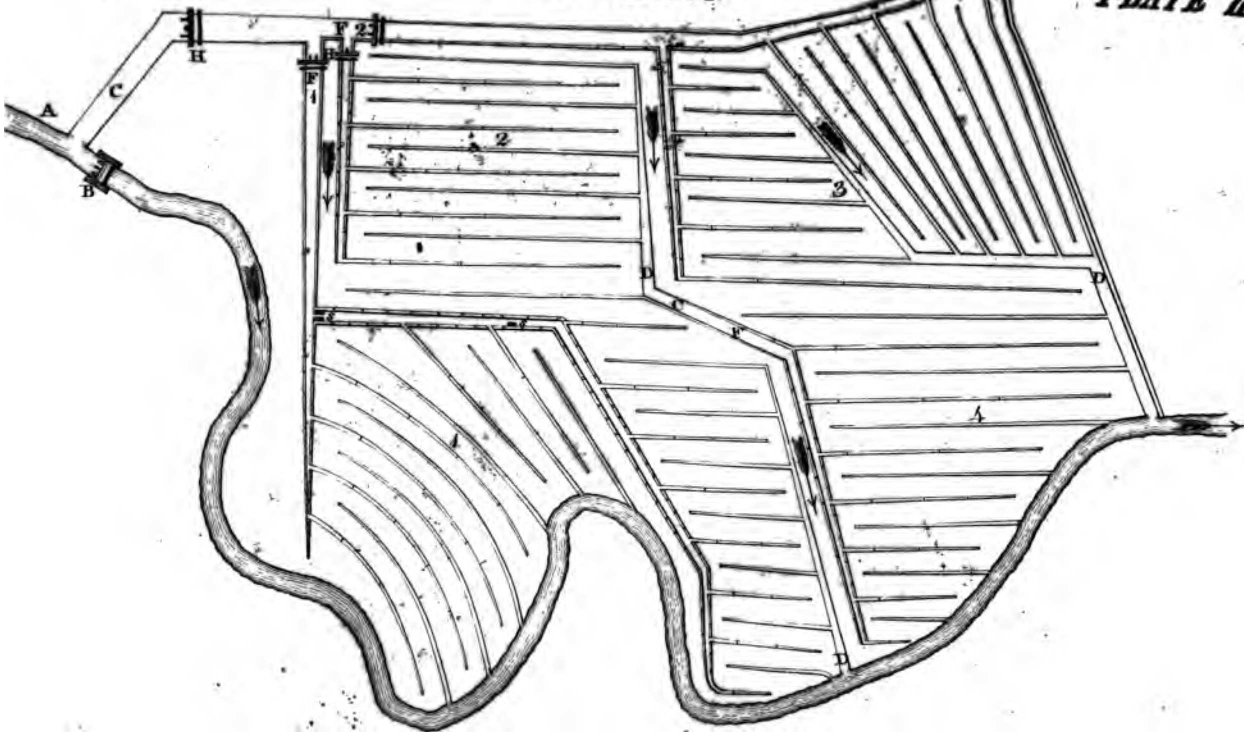
PLATE III.

In this plate, I have attempted to delineate a flooded meadow, formed from a piece of land which had an irregular surface and shape, and had been formerly ploughed and left out in ridges about 10 or 12 yards wide; some of them curved, some straight, and some angular; *i. e.* wide at one end, and narrow at the other; the ridges at the same time lying in different directions, as represented in the plate. From this circumstance, it was necessary to divide the meadow into 4 divisions, which are numbered 1, 2, 3, 4. The 1st division is watered by the feeder, marked F 1, which has a hatch in its mouth for admitting or excluding the water at pleasure, and is divided into 2 branches. Division 2d is the highest corner of the meadow, and is accommodated with a separate feeder, for two reasons: First, it being higher ground than No. 1, it is evident, that if the gutters had been taken out of the feeder, strong stops must have been raised to keep the water up to it, which are not good to keep in the head of a large feeder; also, when the water fell in the river, the feeder would not be full; and No. 1 being lower, would draw the water so low, that No. 2 would be but badly floated: Secondly, by having a feeder by itself, it can be floated when the other two divisions are laid dry, &c. &c. Division 3d, is accommodated with a separate feeder, which is again divided into two

* With 6 inches of depth at the head, and 12 or 14 at the foot.

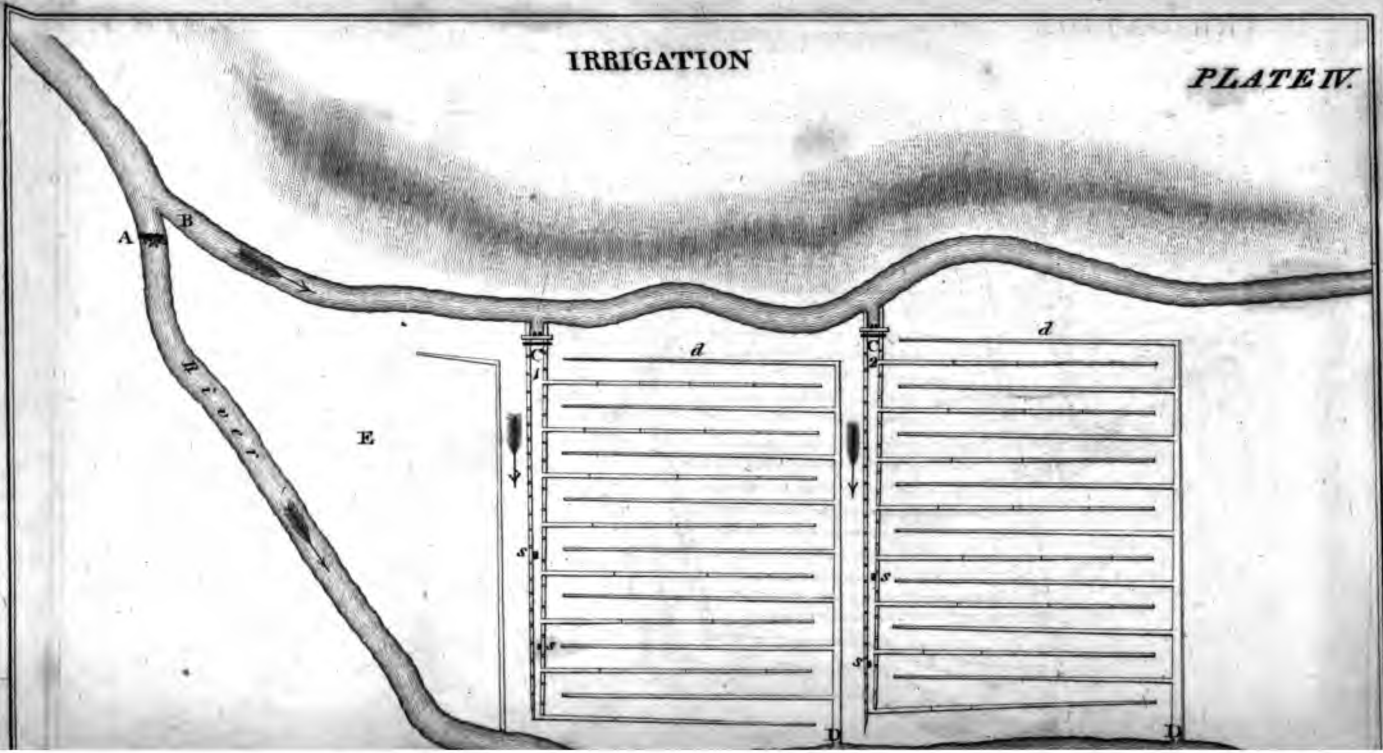
IRRIGATION

PLATE III.



IRRIGATION

PLATE IV.



branches, to suit the position of the land, the ridges lying in two directions, and being of different sizes. Division 4th, is the lowest corner of the meadow, and is found low enough to convert the drain marked D, belonging to No. 2, into a catch-feeder at C F, (which signifies catch feeder.) Division 2d, being rather larger than the 4th, it gives a small additional quantity of water, which makes up a little for the quality, as should always be the case where the water is used a second time. It is supposed, that in ordinary times the river gives water for F 1, or the double feeder F 2, at a time, and, in floods, for all of them together. When the water is very low, one division may be done at a time. By having a meadow in divisions this way, the process of floating may be alternate throughout the whole winter or floating season.

N. B. From the height of the land on the back side, it is supposed that the conductor marked C must be taken out of the river at A; and that, from the height to which the water is wanted to be raised, a frame of hatches is wanted at B, which are to be taken out and put in at pleasure, that the water may be let down its channel in the summer. As, by keeping it up, it might occasion damage to the adjacent lands in heavy rains, the hatch marked H in the conductor, is placed at a considerable distance from the river; as far so, as to prevent the water from getting in behind it in summer floods, when they overflow the banks. This must always be attended to on rapid streams.

☞ If the feeder becomes dry when the water goes down the channel, the hatches at the mouths of the feeder will supersede the necessity of one in the conductor. The 3 principal drains of this meadow are marked with a D. H, at the mouths of the feeders, signifies hatches.

N. B. This meadow is supposed to be irrigated, in its natural state, just as the plough left the ridges.

This plan is quite easy to be understood on inspection, without any farther directions.

This, and the former plate, is designed to answer the first class of land, mentioned in the Chapter.

PLATE IV.

This 4th plate is supposed to represent a piece of water-meadow, made from a piece of haugh land, lying between a stream marked B, for driving a mill, and the river from which the said water is taken out, by means of a rough-built wear of stones at A, which lets as much water pass over it as goes down the mill-stream perhaps:—(These kind of wears are called *Intakes* in the North of Scotland, and the mill-stream is called the *Mill-Lead.*) In this case, it is supposed that the intake, as it is called, is made a little closer, and the mill-lead serves for a main feeder. The piece marked E, is too high for the water, and cannot be floated; but, at C 1, it is found to come out with sufficient fall for floating it. This piece is divided into two divisions, and is supplied with two separate feeders, C 1, and C 2; and two separate main drains, each of which are marked with a D. This division makes it handier, as the mill may spare water for half the meadow, while it could not for the whole. Thus, in this meadow, the process of floating may be alternate, throughout all the floating season.

A simple hatch, like those in Plate VIII., is placed in the mouth of each of the feeders, for excluding or admitting the water at pleasure.

The places in this, and all the plates, marked s, are stops.

As this meadow lies low, and might have been spritty with the sink of the mill-lead, the beds or ridges are made about 10 yards wide, with the small drains between them a little deeper and wider than in Plates II. and III.; particularly the two drains, marked with a d, betwixt the first bed and the mill-lead, which ought to be from two to three feet deep, to keep the sink of the lead from the floated ground, and also to carry off the excess of water that may be pushed over the lead-banks in the time of a flood.

N.B. This and the next plate are designed to answer the third class of land mentioned in the Chapter.

There are many opportunities for meadows of this description in the North of Scotland.

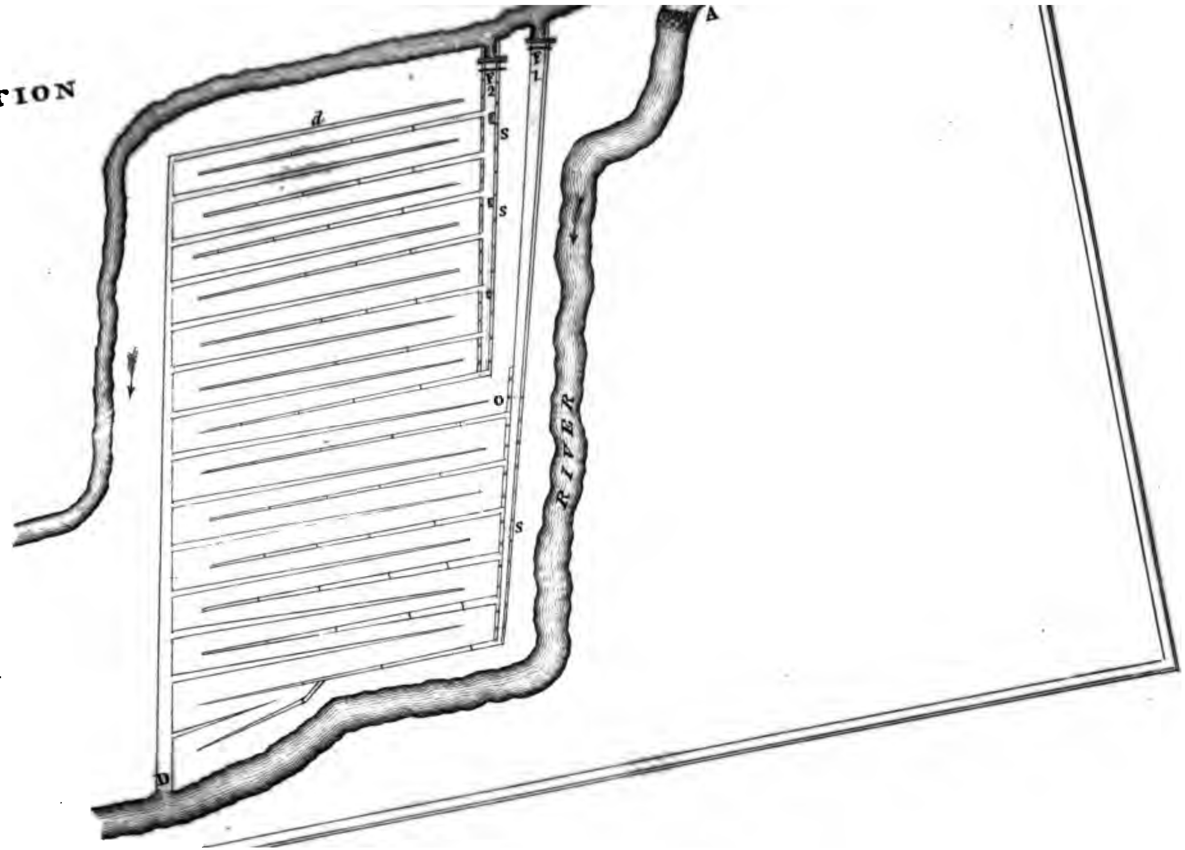
PLATE V.

Plate V. represents another floated meadow, which is supposed to be floated from a mill-lead, like Plate IV.

This mill-lead, marked B, which receives its water from the river by means of a stone-wear at A, is supposed to carry more water than the mill ordinarily requires, (or may be made to do so, by making its intake, or wear A, a little closer); but at the same time, it is found that it can spare but half as much water as the piece to be floated would require. It is also seen, that the one half of the ground is high, and the other low, the lowest half of it lying farthest from the mill-lead. This shows the propriety of two separate feeders, as delineated on the plate.

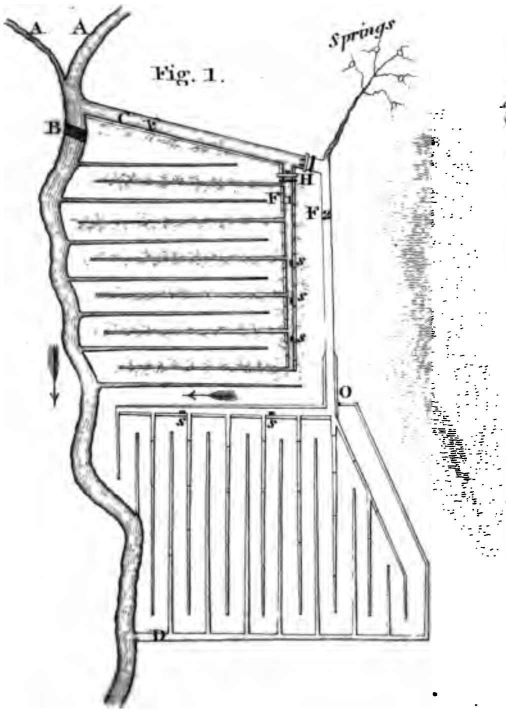
F 1, the feeder for supplying the low part of the meadow with water, which can be done when the water is low in the mill-lead. F 2, the feeder for supplying the high part of the meadow, which requires the water to be a little higher in the lead, to do it properly, than F 1. It is supposed that, in floods, when there is an excess of water, both the divisions may be done together; at other times, they may be done alternately. The advantages of laying out a meadow of the above shape in this way, are these:—1st, As there is a considerable fall in the ground from the mouth of F 1, to where it begins to operate at

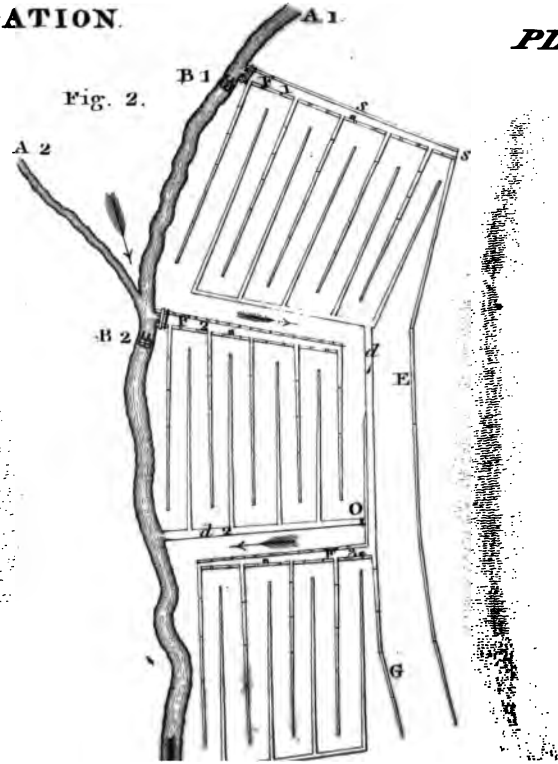
IRRIGATION



IRRIGATION.

PLATE VI.





O, three or four stops would be wanted in the feeder, to force the water out on the high ground: 2dly, These stops would require to be altered and realtered every time the water was removed from the high to the low ground, and *vice versâ:* 3dly, A hatch would be required at O to keep the ground dry below, which would be as expensive as the one at the mouth of F 2. All of which circumstances put together, would render it as expensive as the way described on the plate, and would be very intricate and troublesome to manage; whereas, in the present way, it is quite simple and easy.

As this is supposed to be wet, spritty land, of the third class, a deep drain is made at d, for keeping off the sink of the mill-lead; and the beds are in general about eleven yards wide, and well drained between.

PLATE VI.

FIG. 1. is supposed to be a bog (like class 4th mentioned in the Chapter) lying between the foot of a hill and a stream of water, and abounding with springs issuing from the brae of the hill, which are all drained off by means of the drains in the meadow, except the upper ones, which are conducted into the second feeder, which forms a drain from thence to O, where it becomes the feeder for the second division when the water is on that part of the meadow, it being considerably lower than the upper part, by which means it gets the addition of these springs: At other times, the runnings of these springs are let out at O, and pass down a drain cut for taking off the sink of the hill, &c. and are conveyed by the drain D into the stream. The advantages of two separate feeders are the same as in Plate V, which I need not here repeat.

The water for floating this bog is taken out at the junction of two small streams A A, and is forced into the conductor and feeder, marked C F, by a dam or wear in the stream at B, the conductor being nearly level, or no more fall in it than is necessary to make the water move properly; by which means it waters the piece below it as it goes along towards the uplifted hatch at H, where it enters F 1, and is forced out by the obstructions of the stops (marked s) through the notches in the sides of the feeder, and also into the floating gutters, and is spread over the land as represented in the figure. The other hatch in F 2, is shut down, which keeps the water up to a proper height; and when it is taken up, the other is put down. F 2 being lower than F 1, drains the water low enough in C F, to prevent its flowing out at the notches in the lower side, by which means the two divisions in the meadow may be alternately wet and dry; but, in a flood, both feeders may be open together.

The beds in this meadow are only 10 yards wide, with deep drains betwixt them.

FIG. 2. This figure is designed to represent a floated meadow formed in a narrow valley by the aid of two small streams, A 1, and A 2.

Here the stream, by being dammed up at B 1, is found to force the water into F 1, (without having recourse to fetching the water from a distance, as in some of the preceding plates), which floats the upper part of the meadow, and also the edge of a brae with the gutter E, and waters the space betwixt it and the drain d 1, and the gutter G, where it is a kind of catch-work. The water that runs off the upper part of the meadow, and off the brae, passes down the drain d 1, and fills the feeder again for floating the lower division at F 3.

The middle division is watered by F 2, which receives the conflux of the small stream A 2, by its being obstructed by the dam B 2. There is an aperture at O, for letting the waste water out of d 1, down d2, when the first two divisions are laid dry.

N.B. By using a part of the water twice, the whole meadow is watered at one time; and, by the simple hatches in the mouths of the feeders, it may be all laid dry, and the water pushed down its wonted channel, by slackening the dams a little; which may easily be done, if they are put in with stakes and sods; and if covered with stones, the water may flow over the top of them.

This meadow is supposed to be made on land of the first or second class, mentioned in the Chapter.

PLATE VII.

Is designed to represent the different kinds of catch-work applicable to the North of Scotland, or any hilly country.

FIG. 1. represents a few ridges which have formerly been ploughed, lying betwixt a hollow at the foot of a hill, and a small stream of water, marked A.

In floating this piece, it is found that the water can only be taken out into the feeder F, at the dam B. The stream of water being but small, with a great descent on the ridges; in order to make the most of the water, the drains are taken up at C G (which signifies catch-gutter), and are angled across the sides of the ridges, until they become floating-gutters again. A large ditch is carried round the meadow, up to D, to keep off the sink of the hill, and also to drain the hollow. As the feeder F is upon a level; when the water is quite scarce, one or more of the beds may be floated at a time, by stopping up the mouths of the other gutters with a sod or two, or a bit of board. This simple figure will be immediately understood, by looking at the plate.

FIG. 2. In this figure, floating is represented on the side of a sloping brae. The feeder F is taken out of a small stream that has a great declivity, by means of the dam placed in it at D. This feeder is carried along the face of the brae, diagonally, un-

IRRIGATION.

PLATE VII.

til it comes to the outside of the uncultivated ground: It is then bent down to the drain, which catches a part of the water that has already flowed out of the feeder: It is then again carried across the declivity as before, until it return to the outside of the brae, when it is again bent down to the drain as before, and used in the same way; and so on. Stops are placed at the turns of the feeder (as marked with an s) for adjusting the water; so that a little of the first and best of it may be continued through all the work to the end, which makes up for the waste it undergoes by a part of it always falling into the stream. By the help of the stops, any part may be floated or laid dry at a time. The small lines marked with a T, are small trenches, three or four inches wide, for watering the corners of the brae that the feeders leave out. The drains and gutters are made nearly upon a dead level aslant the brae. This will be easily understood by consulting the plate.

FIG. 3. In this figure is represented a floated meadow on a small scale, done from a small stream of water. The upper part of it is two ridges, formerly ploughed, and floated in the flat floating way from F 1. The next part is on the side of a sloping brae, and is floated in the form of catch-work direct; with this difference only, that the cross feeder is at one end, instead of across the centre of the declivity, which would be at the dotted line C. By the feeder 2d, marked F 2, the water is carried along the edge of the declivity, on nearly a level line, until it reach the brae and the cross feeder, where a little of the first and best of the water is let into every one of the catch-gutters, (for so I may call them, as the second catches the water that flows from the first, and the third from the second.) One or two of these beds may be floated or laid dry at a time, by the help of the stops at s, or by opening or shutting the notches at the end of the gutters, marked with *n*, where the water will fall down the drain d d, or drying drain, into the stream. I think this way of forming catch-work direct, better than the other way of having a feeder down the centre of the declivity, as it prevents the necessity of having the gutters upon a dead level, and at the same time gives a better opportunity of drying the ground when required. A hatch or dam is placed in the feeder at H, by which the two parts of the meadow may be watered alternately.

These two last figures are adapted to the second class of land mentioned in the Chapter.

N. B. Catch-work should never be adopted, except where flat floating is not practicable; but as it must be sometimes adopted in hilly countries like the North of Scotland, let this rule be always strictly adhered to, viz. To continue the feeder from the first to the last gutter, particularly when there are more than two beds, one below the other; for it is evident, that the water used repeatedly in the gutters one after another, would do very little, or rather no good, in the lowermost beds, as it would leave the best of its nutricious particles on the uppermost bed; from which it appears that the contents of the water thus used would not be equally distributed over all the meadow, which it should be. But by continuing the feeder to the end of the meadow, as before directed, and described on Fig. 2. and 3. of last plate, and shifting the water from one bed to the other occasionally, this defect is remedied.

One or other, or a part of one or other of the figures on the seven foregoing plates, will be found applicable as a rule by which to form floated meadows in the North of Scotland; they being designed on the principles of the floated meadows already formed there, and on the natural position of the country.

It must be observed that the size of the feeders, gutters, drains, &c. are not in exact proportion to the length and breadth of the beds, but are a little larger, to make the plans more intelligible; the scale being too small to admit of keeping the exact proportion, and at the same time illustrate the work. But the exact proportion that they bear to each other, will be found in Fig. 1. of Plate I.

It may be observed, that where large floated meadows are formed on a large and rapid river, care must be taken to allow the water room by which to flow over the banks in floods, betwixt the wear and the hatches in the mouth of the conductor. In this case, the hatches should be at some distance in the conductor from the river, as in Plate III.; at least some plan must be adopted to give the water scope, and to keep it from getting in behind the hatches in the conductor, as it would hurt the grass or hay in the summer time, as observed in the explanation of Plate III.

PLATE VIII.

This plate is designed to represent the simple hatches mentioned at page 130. They may be made of any size, from a foot and an half wide to $3\frac{1}{2}$ feet wide single, and to 6 or 7 feet wide double, but not above 2 feet deep.

FIG. 1. of this plate shows the frame, made of four pieces of wood, of 4 or 5 inches square each; or, which is better, $3\frac{1}{2}$ inches thick, and 5 broad, as the additional breadth gives the side-boards a better hold of the posts. A, is the top of the frame, into which the two side-posts B B are tennered. C, the sole of the frame, about 12 or 13 inches above the end of the posts at the black line. After this frame is tennered together and pinned, side-boards about $1\frac{1}{2}$ or 2 feet long, are joined into one another by ploughing, and are nailed upon the sides, as represented in Fig. 2.; and also, upon the ends of the posts at the bottom, two boards are joined together, and nailed on. Thus, in Fig. 2, A represents the top of the frame; C C, the side and

IRRIGATION

PLATE VIII.

Fig. 1.

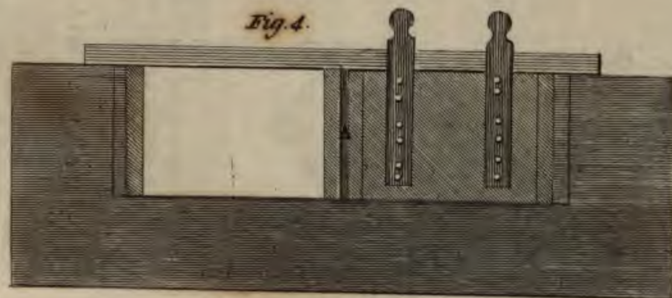
Fig. 2.

SIMPLE

HATCHES and SLUICES

Fig. 3.

Fig. 4.



bottom boards, 1 or 1¼ inches thick, nailed upon it; B B, a space left on each post about 1¼ inches broad for the hatch, Fig. 3, to slide into, the ends of the boards holding the hatch exactly in its place. In Fig. 3, A represents the body of the hatch; B B, the two handles whereby to take it out and in, and also for holding the hatch together.

FIG. 4. shows a double frame upon the same principles, with a post in the middle, and a small strip of wood nailed upon it, marked A: this strip keeps the hatches in their places without letting them move from side to side, as they would otherwise do when the one was out and the other in, as represented in Fig. 4. These boards that are put upon the sides must not cover all the face of the posts, but must leave 1¼ inch bare on the inside of the frame, as before noticed. The above will be easily understood by consulting the Figures.

The mode of fixing the frame is simply thus:—The aperture of the frame must be fully as wide as the breadth of the feeder for which it is designed: And the frame being made, a notch is cut in each side of the feeder, equal to the length of the side-boards; and also into the bottom of these notches, and into the bottom of the feeder, to the depth of the bottom-boards and posts betwixt C and the black line Fig. 1. and the bottom-boards Fig. 2. or 4.; always observing to place the bottom of the aperture rather below than above the bottom of the feeder, that the sole, C, Fig. 1., may have a firm hold of the bottom. When the frame is thus set into the notches, and driven firmly down, the notches may be made tight about the sides and bottom by ramming or beating in stiff clay, which is best for holding it close; but strong sods or feal will do; or even peat-moss, if clay cannot be had. A few stones may be causewayed into the bottom behind the frame, if the force of the water tends to wear it. In solid ground this frame will answer very well, fixed as already described; but where the land is gravelly or loose, the board must be made longer and deeper on the sides and bottom, and a few stones added on the sides, to keep up the banks, &c. I have seen a frame of this description driven down by force into peat-moss, or soft-bottomed land, after cracking the sward at the top; and was thus rendered quite tight, without any more ado.

This kind of hatches will answer in feeders from 2 to 6 feet wide, where the depth does not exceed 2 feet, or 2½. A slab is placed behind these hatches, for the person to stand upon who draws them. This slab or plank is the better to be placed close to the back of the frame, and to have a good hold of the banks, for supporting the head, or top, of the frame.

Where the above kind of hatches cannot be adopted in taking water out of mill leads, and where the fall is great, a trunk 6 or 8 feet long, 1½ or 2 feet square, with a hatch in its mouth, will do very well. This plan I have adopted when the water was taken through a high bank, and the feeder but small:—The earth is put upon the trunk, and the bank made up again above it. This prevents an excess of water from coming out in floods, where the stream is fluctuating.

SECT. I.—*General Directions.*

WHEN a meadow is formed on the principles of any of the foregoing plans, and the principal feeders and drains, with the floating-gutters and small drains cut out, feeder-banks made up, tumps taken down, hollows filled, and the most of the drain stuff wheeled and otherwise disposed of; then let in some water with caution into the feeder and gutters: By this means you may rectify the stops in the feeder and gutters, by making them tighter or slacker, more or fewer in number, until the water is properly sized. By the water you will also see whether there is any deficiency in the feeder-banks; in their being either too high or too low in any part; which it is best to remedy while you have drain stuff to dispose of, and the work is new. When the feeders are got right, then try the gutters, and correct any faults you happen to see; then cut notches through the sides of the feeder-banks, two or three inches wide, and also through the sides of the gutters. This done, increase the water; and it will flow over the sides of the beds, by means of the notches and the obstruction of the stops, and the diminishing of the gutters. This done, it will be seen if there is any tump that the water does not go rightly over, or any hollow that it stands in; which defects may now be rectified, and all made smooth by the help of the water, which is the truest criterion for finishing a meadow by. I have always found that in levelling rough land, the sooner the water was admitted the better, as it prevents any useless work. When the surface is all got smooth and all the stuff disposed of, and the feeder-banks levelled, as above; a little more water may be admitted, but always with caution; because if a great force of water be admitted before the work becomes firm, it will endanger it, or would run down some of the feeder or gutter-banks, particularly if it was formed from recently ploughed land, or if there was much levelling upon it. This shows the use of the notches for the first year or two, which I have introduced in Plate I, both in the feeder and gutters, and also in the feeders represented in the succeeding Plates, the scale being too small to show them in the gutters. After the work has stood for one year, and is grown firm together, more water may be admitted, and used more freely; and in two or three years it may be made to flow over the banks, in general, without notches, as the banks will then bear it; and, the quantity of water being increased, it will naturally do so, if the stops are kept to a right pitch. After the work is finished, observe if any of the feeders or gutters carry too little water; and if there be any such, mark the place; and the next season, when the work is trimmed up, widen that place a little: The stuff so produced will be found useful for making up any places that have sunk in any of the hollows that the feeder-banks are made through, or elsewhere. The first year's grass may be mowed over the whole ground, or it may be pastured with sheep. Heavy cattle cannot be admitted while the work is tender, as they tread and tear the works to pieces. Where there are no sheep, if the ground is much cut up, it is better to cut the rank spots, and let the rest rot upon the ground: the more there is left in this way on the broken places of the surface, the better, as it filters the water the better the next season. I have always found this last way answer very well here in the North of Scotland. But, when the meadow is two years old, black cattle may be admitted with freedom.

On poor land, or where it has been much cut up, a great crop of grass is not to be looked for before the second or third year, as it must be progressive until the land be properly enriched, which will require less or more time according to the state of the land, and the quantity and quality of the water.

Thus, the piece done at Pitfour, for Mr Ferguson, last year, which is about 3¾ English acres, (which, together with the remainder of the same piece, that lies above the reach of the water, makes about 5½ English acres in whole), let, before it was floated, for about 30s. or 40s. altogether, and let that same year, when the work was new, for 3*l*. This year it let for 11*l*. 14s.; and by next year it will be worth more. This piece cost 16*l*. in making, exclusive of a hatch, and may cost 20s. or 30s. per annum for keeping in repair.

The piece mentioned in the Chapter, of about 18¼ English acres, has let in past years at about 4*l*. per acre; but this year (1813) it let at 80*l*. in all, or 4*l*. 8s. per English acre. This shows that floating is a progressive and perpetual improvement.

SECT. II.—*On the Practice of Irrigation.*

A FLOATED meadow, when formed and brought to a full sward surface, as mentioned in the last Section, must undergo an yearly repair. Thus, in the month of October, when the aftermath is ate off, the banks of the feeders must be repaired where broke down by the cattle, and the sand or mud that lodges in any of them thrown out. The sides of the feeders and gutters may be trimmed with a large sharp reaping hook; and the bottoms may get a slight shovelling out, more or less, according to the quantity of filth found in them: This stuff so produced, must be trod down smoothly at the back of the gutters, or put into hollow places, &c.; but it must always be observed, not to clean the floating gutters so hard at the lower end as at the upper, that the diminishing proportion of its size may not be destroyed, which I have seen sometimes done by people inexpert in the business, as where and when it was necessary to pare the sides with a spade.

The drains will do with cleansing once in two or three years in the North of Scotland, as there is not a long time for pasturing here with cattle when the crop is cut for hay.

The stuff produced from the cleansing of the drains, is put into hollows, or used to mend the low places in the feeder-banks, &c.

N. B. The works should always be got ready in October to receive the autumnal floods in November; and even in October, if the work was not all cleansed, and a flood was coming down after a heavy rain, it should be turned into the meadow, particularly if the meadow was two or three years old. These first autumnal floods bring a great quantity of putrescent matter along with them, which is particularly enriching to the soil. If the water is turned in before the works are cleaned up in a flood as above; when the flood ceases, the water can be taken off again to finish the cleansing; and when that is done, it should be put on again in the beginning of November, with intermissions for the floating season, which in the North of Scotland, must be from the 1st of November to the 1st of June, *i. e.* for seven months.

The process through the floating months begins thus:—In *November*, the water is used very plentifully for three weeks or a month; at the end of which time it must be taken off for a few days, or changed to another part of the meadow, as no grass will do without having the water sometimes taken off from it, to give it air: besides, if it runs too long on one place at a time, a scum is engendered which is poisonous to the grass, although it is not so soon produced here as in Gloucestershire, because the climate is not so warm.

In *December* and *January*, the water is used, as much as can be here, to shelter the ground and enrich the soil; but there is here no vegetation in these two months, owing to the lowness of the temperature of the air; the heat being below the vegetation point. In these months, the process of floating is sometimes intermitted by the frost. In very frosty weather, it is better to take off the water from the meadows altogether if it is severe, and likely to continue long; but this must be done at the beginning of the frost; otherwise, where there are hatches, in two or three days and nights frost, they will be so firmly frozen, that it will be found impossible to remove them. However, as there is no grass on the meadows here at this season, the only hurt that the frost does is, the ice in the feeder takes such a strong hold of the banks, that, by its expansion, it breaks pieces out of them; otherwise the ice, when it hath given a complete sheet to the land, keeps it warm, and the water sometimes runs under it: But if these months are not frosty, it will be necessary to give the meadows air once in two or three weeks, less or more, to prevent the engendering of scum as aforesaid, and to dry the land.

In *February*, the management is much the same as in January; only, if it be without frost, the water will require to be taken off or changed more frequently, as, about the end of this month, if the weather be mild or sun-shiny, the scum will begin to make its appearance again, if the water be continued too long on one place at a time, *i. e.* more than about two weeks. The Plans of the meadows that I have given, show, by divisions, how the water may be removed alternately from one to the other through the floating season.

In *March*, as the vegetation sets in, care must be taken to shelter the young grass as far as possible; and when the water is changed or removed, a mild day must be chosen for it; and it is best to do it in the morning, that the ground from whence it is removed may be dry ere night, which enables it to stand a frosty night the better. In this month, scum must be guarded against as much as possible; but, instead of changing the water at stated times, it should be done according to the weather, always taking the advantage of a good day, which may vary the time from a week to once in a few days, less or more.

In the month of *April*, the water is used more sparingly, and changed more frequently, as the month advances, and the grass gets up. The same rules and cautions are to be observed in this month, in changing the water, as are recommended in March. In this month water is of great advantage in sheltering the grass from the cold winds, night frosts, &c.

Month of *May*.—In the beginning of this month, as the weather becomes warm, the water must be used more sparingly, and frequently changed; once in a week at least: and towards the end of it, the water should be changed or taken off once every three or four days, always observing to take a good day for it, and to do it in the morning, as before recommended. By the end of this month, or the first day of *June*, the grass will be so far advanced, as to need no more water for the season; and at that time, when the water is taken off the meadow altogether, the meadow should be made completely dry, by opening all the apertures in the feeders that communicate with the drains, as shown on Plate II.

N. B. Through all the season, the engendering of scum (as I said before) must be guarded against, particularly in April and May. This scum shows itself first in the following way:—When the water hath run too long on one place, *i. e.* five or six weeks without intermission, a brownish green substance will be seen adhering to the grass and its stools, and floating or moving with the water like a hairy kind of wool, which, if not checked by removing the water, will soon turn thicker and greener, and lastly into a white scum, which, when dry, will adhere to the grass like old rags or paper: The first appearance of this scum is preceded by air-bubbles on the water; and if the water is removed when these appear, the scum will be prevented.

This scum seems to be produced by the fermentation of the water; after which, it sours, and undergoes decomposition; which perfects the scum, and makes it separate from the water. The slower the water moves, the sooner this scum is generated; and stagnant water, in hollows, is the worst for doing so of any; by which, and the exclusion of the air from the ground, the grass in hollows is very short and sour, as it grows none while it is thus immerged; and would die altogether, were it not for the heat and air that it gets in the summer months, when the meadow is perfectly dry. This shows the necessity of making up the hollows in a water meadow, and of giving the beds in it a good falling slope from the feeding gutters to the drains, that the water may move quickly over the surface: They should be like the sections of the beds described on Plate I, Fig. 2, and as treated of under Sect. IX. on the formation of a water-meadow.

During the floating season, it is requisite that each meadow should be inspected at least once in every week or ten days, to see that the equal distribution of the water is not obstructed by the continual influx of rotten rushes, or stubble, weeds, leaves, sticks, and the like, provincially called *water-wreck*, or *rack*.

CHAPTER XIII.

APPENDIX.

OF EMBANKMENTS.

By the Rev. JOSEPH ROBERTSON.

A KNOWLEDGE of the most effectual method of embanking land, is of essential importance in a general system of improvement. Embankments serve, in agriculture, a purpose similar to what fortifications do in the art of war. They protect from invasion, and secure acquisitions. They not only enable the husbandman to defend the soil which he possesses from encroachment, and to prevent the fruits of his industry from being swept unexpectedly from his grasp; but afford a mean of recovering from the sea or rivers those lands which, for want of such a protection, have in the progress of time been overwhelmed.

From the important advantages attending embankments, it would seem just to conclude, that they could not be long neglected in any country where agriculture had attracted a competent share of attention; more particularly, in one whose limited extent makes the acquisition of productive land an object of primary magnitude, the largeness of whose consumption renders any disappointment in its usual resources a cause of serious distress, and the intelligence of whose inhabitants ranks high in the estimation of the world. Yet, though such a country is Britain, and such the character of its inhabitants, there is perhaps, in a comparative view, none in which the system of embanking has been more overlooked.

In some places, indeed, exertions have been made in this way which mark a high degree of spirit and improvement. In Yorkshire, in Lincolnshire, in Cambridgeshire, in Cheshire, and in several other English districts, many hundred thousands of acres have been recovered from the sea and rivers. On the western coast of Scotland and in the Hebridian isles, large acquisitions have also been made. But still immense tracts, along the coasts and on sides of rivers and lakes, remain under the power of water. By the embankment of Lancaster Sands alone, the expense of which, it has been estimated, would not exceed 150,000*l.*, no less than sixty square miles of land might be gained. And among the Hebridian isles, it has been calculated, that above 20,000 acres still remain to be reclaimed from the sea. It must be farther noticed, that there is scarcely a river in all the country that flows through flat land, which, for want of proper embankments, does not commit, every season, great devastations upon its banks, either rendering large tracts unproductive, or sweeping away the harvest they have reared.

In attempting to mark out the causes of this general neglect, it is impossible to join with some writers, who endeavour to trace it to the facility with which this country has, till lately, obtained supplies from abroad, or to any general impression of security which may have prevailed in that respect. There is no instance in which individuals were ever found to be guided by such general and distant considerations of policy in their private conduct. Every man is sufficiently anxious to secure the harvest of his labour, and to protect his lands from encroachment, as well as readily disposed to fall into any measure that offers a fair prospect of territorial acquisition; and it is folly to imagine that his endeavours will, in the smallest degree, be increased by any impression of what the country might either suffer from his negligence, or gain by his enterprize.

Perhaps a more immediate cause of the inattention to embankments may be found in the general prosperity of our manufactures and commerce, which, by affording a quicker return of profit than any other branch of industry, have hitherto attracted the bulk of the national capital. For, when we consider the great expense, and in some cases hazard, that attends embankments, there can be no doubt that a want of capital must have operated more severely against this, than any other branch of rural improvement. At the same time, a great deal must be attributed to the inattention of landed individuals to their property, to a narrow jealousy of the prosperity of tenants, and to a want of cooperation among adjoining proprietors, arising from opposite views of interest or different feelings of enterprise.

It is, however, to be hoped, that as agriculture is every day becoming a more favourite object of pursuit; that as proprietors are in general bestowing more attention to the improvement of their estates, and of course imbibing more just ideas of things, the system of embanking will be as generally adopted as, from its importance, it merits.

CHAPTER XIV.

APPENDIX, No. 1.

ON LIVE-STOCK.

IN the Fourteenth Chapter of this work, the several species of the agricultural live stock of Scotland, and the varieties of each, have been treated of at some length, but with only a general reference to the districts which they occupy. In this article, it is proposed to mention the live stock of each county: and, when that can be done, to notice their numbers and value. It will here be proper to attend to those kinds of animals, which, owing to their value being comparatively inconsiderable, or their importance to the husbandman being merely local, it was thought unnecessary to describe, in the Chapter itself. Rabbits, Poultry, Bees, &c. shall therefore be noticed among the live stock of the several counties, and more particularly of those in which they have been found the most valuable. The arrangement of the counties that has been adopted in the First Chapter and its Appendix, may be followed on the present occasion.

I. THE ARABLE, *or* SOUTH-EASTERN DISTRICT.

1. *Roxburghshire.*

1. *Cattle.*—There is no breed of cattle peculiar to this county. In the more level and richer parts, they approach in size and shape to the improved Short Horns of Northumberland and Berwickshire, and weigh, when fattened, usually at four years' old, from 60 to 80 stones avoirdupois. On the higher grounds, they do not much exceed half these weights; so that the average weight of the fat cattle of the county has been stated at from 45 to 50 stones. A great many are brought from the Northern counties, some of which are fattened, and the remainder sold to graziers from England. The number of all ages and sizes fed annually, is supposed to be upwards of 6000, of which about two-thirds are sold in the markets of Morpeth in Northumberland, and those in the county of Mid-Lothian.—A very few oxen are still worked, commonly in pairs, without a driver; but none of them are employed in distant carriages, and very rarely in carting even upon the farm. In 1796, when the Report of the county was written, about 2000 calves were fattened annually; and the number has probably increased since. Very little cheese is made, and perhaps no more butter than is required for the consumpt of the inhabitants, and for salving the sheep. The whole number of cattle in the county is not mentioned in the

eport. If 4000 fat cattle are carried out of the county, weighg 50 stones each, their value, at 8s. a stone, will amount to 0,000*l.*; but as it is not known how many of these have been ormerly brought into it, it is impossible to ascertain what number has been reared within the county. A great many cows also are sold lean, chiefly to the cowfeeders of Edinburgh.

2. *Sheep* have long formed the most valuable part of the livestock of this county. On the higher grounds, they are of the Cheviot breed; on the skirts of the hills, they have been crossed with the Leicester or Dishley breed; and the latter is now found in considerable numbers on almost all the low lands on the banks of the Tweed and Teviot. The number of the Cheviot breed may be about 200,000, kept on rather more than as many acres; and the total number of all kinds has been stated at 266,370. At 25s. a piece, their value will amount to 332,962*l.* 10s.; and that of their wool, at 4s. a fleece, to 53,274*l.* Of the annual sales of sheep, of all ages, no account has been obtained. A few of the South-down, and other breeds, have been introduced; but their numbers are inconsiderable.

3. The *Horses* of this, as of the other Lowland counties of Scotland, are of different breeds, but generally well adapted to the labour of the varied surface of the country. On the lower arable land, they are strong and active, though not quite so heavy as the horses of Berwickshire and the Lothians. Their number, in 1796, was 4996, of which 586 were chargeable as carriage and saddle-horses. A part of these, however, were workhorses liable to this tax on account of the rent of the farms. At that time it was thought the county did not breed horses sufficient to keep up its stock.

4. *Swine* are kept in considerable numbers by millers, brewers and farmers; and almost every hind or married ploughman has a pig for at least a part of the year. They are generally of a middle size, and weigh, when fattened at about a year old, 10 or 12 stones each. Besides supplying the consumption of the county, a great many carcases are sent to Berwick, where they are prepared for the London market.

5. *Poultry* are seldom reared for sale by farmers; yet there are many of all kinds in the county; especially of dunghill fowls, whose eggs, which are purchased by people who travel over the county, and carried to Berwick, bring no inconsiderable sum. The people of Hawick alone, according to the Statistical Account, received 50*l.* weekly at an average during the year, for egg sold at Berwick. Ducks, Geese and Turkeys, are not so nu merous.

There are no Rabbit warrens; but several Pigeon-houses; a the number of Bees is supposed to be adequate to the supply the inhabitants with honey.

2. *Berwickshire.*

1. The *Cattle* of this county may be described in nearly the same terms as those of Roxburghshire; except that, upon the richer parts of the Merse, they are of a greater size. They have been much improved by crosses with bulls of the Teeswater breed. None of the oxen are worked.

2. The *Sheep* in the districts of Lammermoor and Lauderdale are mostly of the Black-faced or Mountain breed, and, in the Merse, of the Leicester or Dishley, which are bred there in great perfection. On the edges of the moors the Cheviot breed are kept; and a cross-breed between the Leicesters and Cheviots occupy the intermediate situations.

3. *Horses* are now reared in greater numbers than formerly; but the best work-horses are still brought from other districts, chiefly from the counties of Ayr and Lanark. The number was estimated at 4500 several years ago; and 6000*l.* was considered the average yearly expense of keeping up that stock. But since horses have brought such high prices as of late years, it is not improbable that the county may nearly supply itself.

4. The *Swine* of this county are of much the same breeds as in Roxburghshire, and are sent to the same market.

There are no Rabbit-warrens; but few Dove cots; and neither Poultry nor Bees are considered objects of importance to farmers, though they are by no means neglected altogether. Eggs find a ready market at Berwick, to which great numbers are sent from all parts of the county.

3. *East Lothian,* or *Haddingtonshire.*

1. *Cattle.*—Very few cattle are reared in this county. Every farmer keeps a small number of milk-cows; but few keep more than are sufficient to furnish a regular supply through the whole year, of milk, butter and cheese, for their own families. Not much attention is therefore paid to breeding, the greater part of the cattle wintered in the straw-yards, and fattened on turnips or grass, being purchased at Falkirk, or at Hallowfair in Edinburgh. A market for cattle has been lately established at Haddington.

2. *Sheep* are kept on the low grounds, on turnips, sometimes on sown grass; and are sold off as soon as they are fat, which is usually within the year. Permanent flocks and regular management may be said to be almost confined to the higher parts of the county. The Black-faced are most generally preferred for fattening, as they sell better in the Edinburgh market. Many of the Cheviot breed are likewise kept, and there are several flocks of Leicesters. On the higher grounds of Lammermoor, the Black-faced are the most prevalent variety, as well as in that part of the district which belongs to the county of Berwick.

3. *Horses.*—' What has been said with regard to other kinds ' of live stock, will apply also to horses; very few are bred in ' the county, not perhaps one in a dozen that are kept.' The farmers are supplied chiefly from Ayrshire and Lanarkshire.

4. *Swine.*—Of these there are considerable numbers in this county, though their flesh does not form a general article of food to the inhabitants. The principal markets for them are Leith and Berwick, where they are bought for victualling ships.

There are not many Rabbit-warrens in this county, and the number of Bees has much diminished. Poultry and Pigeons are considered to be not merely unprofitable, but to occasion a positive loss to the farmer.

4. *Mid-Lothian*, or *Edinburghshire.*

1. *Cattle.*—The breeds and breeding of cattle have been little attended to in this county. Milk-cows, however, highly deserve notice in so populous a district; yet they consist of almost every kind in Britain. The cows kept in Edinburgh are brought principally from Roxburghshire, Berwickshire, and East-Lothian. In other parts of the county, Highland cattle are purchased for the straw-yards, for fattening on turnips, and for grazing.

2. *Sheep* are almost confined to the hills, and are chiefly of the Black-faced breed. The Cheviot and other varieties have been introduced into several situations.

3. *Horses.*—In 1796 the number of horses kept for the purposes of husbandry, was estimated at about 5000, of which not one-half was reared within the county. About 600 were purchased yearly from the Clydesdale breeders to support this stock. Since that time, breeding has become more common.

4. *Swine* are not bred to a great extent, except at mills and distilleries. The Edinburgh market, however, is always well supplied with pork; but the use of it is not yet common among the lower ranks.

There are few rabbits kept in the county. Of poultry,—geese, turkeys and ducks are not reared very extensively. The Edinburgh poultrymen frequently bring geese from Northumberland in hundreds, and send them to the corn stubbles to fatten for the supply of the citizens. Dunghill fowls are much more numerous. ' The money drawn yearly by the peasantry of the county,' (previous to 1796), ' for poultry and eggs, cannot be less than ' 8000*l.*'—*Mid Lothian Report*, p. 162. At the present time, the sum is probably more than twice as much. At that period, there were about 300 pigeon houses in the county, and the pigeons were supposed to consume as much wheat as would at an average, serve as bread to 3000 souls. A few bee hives were to be met with over all the county; and Mr Bonner, the bee-master, was then taking measures to extend this branch of husbandry. This ingenious person calculated the produce of each hive at 4

Scots pints of honey, and 1 lib. of wax. The speculation does not appear to have been quite so successful as was expected.

5. *West Lothian*, or *Linlithgowshire*.

1. *Cattle*.—The breeding of cattle, except for the dairy, has not engaged the attention of the farmers of this county in a much greater degree than those of East and Mid Lothian. The Fife cows are much approved of for the dairy, and the Highland cattle for fattening; and this county is conveniently situated for obtaining both kinds of stock; the former by the passage-boats at Queensferry, and the latter at the great markets held at Falkirk, in Stirlingshire.

2. *Sheep* are an object of small consideration in this county. A few of several varieties may be found in different parts of it; but the most common stock, which is changed frequently, or what is called a flying stock, is of the Black-faced breed, purchased in spring from the adjacent counties, fattened on grass, and sold in October.

3. The breed of *Horses* has been much improved of late years. It is customary among the farmers to breed rather more horses than are needed on their farms, the surplus being commonly sold for the use of the adjacent counties. In 1796, the total number of all kinds was 2496, of which 1745 were employed in husbandry.

4. *Swine* are now much more generally bred than formerly. The prevalent breed is the short-legged Chinese. The improved Bedford breed has of late been introduced.

There are no rabbit warrens in the county. Turkeys, geese and ducks are bred in small numbers. The common hen is universally reared. Pigeon-houses abound, but pigeons have of late been deemed not so prolific as formerly. Bees are kept all over the county, but have not succeeded for some years past, owing to the late severe springs, and the variable weather which prevailed in the honey-making season.

II. THE SOUTHERN *or* PASTORAL DISTRICT.

1. *Peeblesshire* or *Tweeddale*.

1. *Cattle* in this county are an object of inferior importance to sheep. No other attention seems to be paid to breeds, than what a regard to the immediate views of the farmer may require. Whether milk or beef be the object, it is sought for among the breeds or the individuals of different breeds to which the farmer has access. Cows have been brought from Ayrshire and from Berwickshire for these two different purposes, and the intermixture which is permitted between these and other breeds, has produced cattle stocks somewhat similar to those of the Lothians, except that they are of a smaller size.

2. *Sheep.*—The Black-faced, or Mountain sheep, are known in many parts of Scotland, by names taken either from this county, or the market in it at which they are sold. From the former they are called the *Tweeddale breed*, and from the latter the *Linton breed*. The number of all the sheep in the county is believed to be upwards of 112,000, and by far the greater part is of the native breed. The Cheviot variety was introduced several years ago; but it is still a matter of dispute, whether they are a more profitable stock than the natives, at least in the higher parts of the county. A few of the Dishley and Southdown varieties have been long kept by proprietors in this, as in most other counties of Scotland.

3. The *Horses*, which are not numerous, are similar to those of the Lothians, but smaller in size.

4. *Swine* are kept at corn-mills, and upon the offals of dairy farms: There was long a prejudice against the use of their flesh, which is gradually abating.

Rabbits are found wild in the sand-hills of Linton parish, but there are no warrens. Poultry, pigeons, and bees are only in small numbers.

2. *Selkirkshire.*

1. The cattle of this county are similar to those in the higher parts of Roxburghshire. The number was 2200 about 1796, when the Agricultural Report of the county was written.

2. *Sheep.*—Here, as in Roxburghshire, sheep are the most valuable branch of live stock. They are chiefly of the Cheviot breed.

3. *Horses.*—In this, as in the other pastoral counties, horses are not numerous. According to the Statistical Account, the number was about 550.

With regard to swine, and the inferior kinds of live stock, it would only be necessary, in describing them, to repeat what has been already mentioned under the former county.

3. *Dumfries-shire.*

In this extensive county all the different kinds of live-stock are numerous.

1. *The Cattle* are chiefly of the Galloway breed. Ayrshire cows have been introduced for dairy husbandry; which is, however, very limited in this county. Besides these, there are great numbers of Highland cattle bought at Falkirk and other places, which are kept for only a part of the year. The permanent breeding stock of the county is stated in the Report at about 30,000. The numbers of the flying stock are fluctuating and uncertain. Above 20,000 cattle are supposed to be sold every year on the Sands of Dumfries; 4000 have been shown there on one day in the month of October.

2. *Sheep.* The Cheviot breed now occupy the greater part of the pastures of this county; though the black-faced still prevail in the upper parts of Nithsdale. The Cheviot sheep are, however, seldom unmixed; and the wool never sells so high as that grown on the Cheviot hills. It has been a practice for several years with the owners of this breed in Dumfries-shire, to purchase rams at Hawick from the farmers near Cheviot, with a view to maintain or improve the character of their stocks. Most of the mountain flocks are kept merely for breeding, and consist of ewes and ewe-hogs; there being very few stocks of wedders in the county. This limited scale of management is probably one of the principal causes of the inferiority of their Cheviot stocks. Besides these two breeds, there are a few flocks of Leicesters and foreign breeds. In respect of numbers, it has been supposed, that in the whole county there may be about 200,000 sheep, of which $\frac{7}{8}$ths, or 175,000, may belong to the mountain flocks, and the other 25,000 to the low farms.

3. *Horses.* 'The work horses in general are the result of 'many crossings of different breeds, larger than the real Gallo-'way, but less than the pad-formed dray horse of Glasgow and 'the neighbourhood.' (*Dumfries-shire Report*, p. 374.) Potatoes, which are extensively cultivated in this county, are given to work horses, sometimes at the rate of 42 lib. daily, after being boiled or prepared by steam; and, in some instances, oats are wholly withheld, unless when the horses are employed on distant journies.

4. *Swine.* These form an important branch of husbandry in this county; the annual returns of money for swine into the whole county fall but little short of 50,000*l.* The pork is cured in the county, and sent off in bacon for the London or Newcastle markets. They are fed chiefly on potatoes. The long-eared white sow is generally preferred, as the progeny come to a large size, weighing, when fat, about 16 stones at an average; and some of them reaching as high as 30 stones. The prices for green pork vary from 5s. to 9s.; and for bacon from 9s. to 12s. per stone. The consumpt of pork and bacon, within the county, is conceived to be fully equal to one-third of what is exported out of it. The gross value therefore must be supposed betwixt 60,000*l.* and 70,000*l.* worth; and if every swine fed for slaughter were valued at 5*l.*, there would appear to be about 13,000 fed and slaughtered annually in this county.—*Report*, p. 384.

There are very few rabbits; and no regular warren. Turkeys, geese, common fowls, and ducks, are all reared in considerable numbers. In one small parish, it was ascertained that eggs to the value of 100*l.* were sold in 26 weeks. Pigeons are not numerous.

The intelligent Reporter of this county (the Rev. Dr. Singer,) having described the management of bees at some length, it may be proper in this place to transcribe his remarks.

'The apiaries of Dumfries-shire are by no means well attended to. Not one farmer in ten has any bees; and few of those who have them, keep above two or three winter hives to breed next year: some particular persons have more; and a few of the cottagers have bee-hives in their little gardens.

'The annual produce from bees may be fairly estimated at one pound sterling for each hive; but this depends very much on the season, and not a little on management, attention, and situation. In the best years and situations, with proper attention, a breeding hive may return, in different swarms, and in the honey which they accumulate, several pounds instead of one. In the worst seasons they return scarcely any thing, and some of them die out.

'In summer, the principal and finest pasture for bees is in fields of white clover; and in harvest, among heath blossoms. When there is plenty of both at a small distance, the hives, in good years, generally do very well. Other plants furnish a lesser proportion in fields, woods, and moors.

'About the middle of June the swarming is most active; and one hive generally sends off two, sometimes three, successive colonies. They alight, for the most part, on some bush not far distant, and, after they are all clustered and settled, one person holds an empty hive below them, and another shakes them off into it: the person who holds it then turns the bees gently round in it, in order to let them adhere all within it, and lays it down, inverted, on a board, with a clean cloth below them, and two sticks to keep the hive up about half an inch, and give them free access out or in. The swarm soon collects in the hive; and at night-fall they are all quiet and clustered, and are carried and set down softly on a stool prepared for them; two pared turfs, or divots, being laid across each other over the hive, projecting to the south, and all round, in order to turn rain, and secured with a flat stone, or thick slate, above all. The bees commence working next day, if it be good; and require no more attention till their hive be filled with honey.

'In September, the strong hives, that weigh from 20 to 30 lib., are examined, and some are set apart for breeding, which are well secured with plaster lime, and the door contracted into a small hole of about half an inch every way; and they are set in such a way as to give mice no chance of entry, and covered with straw-hoods to keep warm through the winter.

'The weak hives, not capable of supporting themselves, are for the most part smoked with a linen rag, dipt in melted sulphur; and some of the stronger hives are also smoked, when a sufficient number for standing is left.

'It was the practice formerly to drop the honey, which can only be done when warm and fresh. But the dirty practice of squeezing was also tried, which brought the honey sold under the name of dropt-honey into just discredit. It is now common to sell the whole in the combs, and to keep and use it in that way: but an old hive never answers for this purpose, the combs being dark and dirty.

'With a view to get honey, and yet save the bees, the reporter (in a lucky season) tried an experiment. He suffered the hives to cast one swarm each, and then waited until they appeared crowded with numbers and heat, and ready to throw a second swarm. But, instead of suffering this to happen, the mouth was closed by a soft gauze, or muslin or silk handkerchief, tied all round, in order to prevent egress at night, when all were in, and the centinels at the door. A hole was then cut out of the top, from three to five inches diameter, and the piece being neatly and quickly turned out by the knife, a new and empty hive was placed on the top, and secured with some wooden pins. The handkerchief was then removed; and, after some stir, the bees, finding an upper story, began in the most ardent manner to fill it with combs and honey, which was soon accomplished by their numerous and united forces. In September the pins were softly taken out, the top removed, and the piece that had been cut out (enlarged with two rows of straw work) laid on above, like an inverted plate, pinned down, and plastered over, the hive being left quite full of bees, combs, and honey. In this top the finest combs and purest honey possible were found, without a single particle of dark comb, or bee-bread, or any such thing as young bees, or their cells. And, as not many scores of bees were found in it, there was no difficulty in removing them, and, of course, they went back into the hive. This operation was ventured on with five different hives the first year; and the fine top-honey found above each was in proportion to the time which the bees had in order to collect. The hive that was done in the first days of July was quite full at the top; and the others contained less and less in proportion, down to the latest period of the operation, being about the end of July. The contents of the tops (in the purest honey ever seen) were 22 lib., 14 lib., 11 lib., 7 lib., and 6 lib.: and all the hives left, prospered next year.

'The produce of one hive, in that year, was as under, viz.— Two swarms, which filled their respective hives; and the first laid on 22 lib. of top-honey after filling, the second only 7 lib.; but the parent hive laid on 11 lib. of top-honey after casting twice. Now, if the swarms be valued in their full hives at 2*l.* each, and the 40 lib. of pure top-honey at 1s. per lib. (which are much below the real value), the produce, from one breeding-hive, was in all 6*l.*

'But that season was uncommonly fine; and the success of this method has been very far inferior since that year. In some seasons a little fine top-honey has been obtained; but in bad seasons, when the bees cannot fill their hives, one must see that it can have no success at all. Yet, even when the latter part of the season has been unpropitious, it has not been found that any harm was done by the trial; the piece being put on before winter, and plastered down.

'If the hive be quite full of honey in the combs, and if the season also admit, they will fill the top also with honey. If not, still it affords air to the bees, and may be removed when the season to work is over.

'Early in the season, when the weather was fine, and the bees active, it was observed that they began at once at the top of the cover, and filled it all downwards till they reached the under hive, leaving only the usual passages. But, when the operation was performed late, they seemed to calculate; began sometimes at the under hive, and attached the new combs to it; or carried up a piece of comb of small diameter, as if they had felt conscious of the impossibility of filling it.

'In case any person should think of trying this method, with a view to spare the bees, and, at the same time, to get the finest honey, it would be as well to attend to the following particulars:—That, in a bad season, when the hives are not full, it cannot answer; that, even in the best season, it ought not to be deferred beyond the middle of July; and that it never should be attempted until the hive seems to be full of bees and honey. But, with these cautions, if the season be fine, and plenty of latter pasture for bees, it is an operation that will hardly fail of success, if it be correctly gone about.

'A smooth plank of ash, from one to two inches thick, with one pillar wedged into the middle, and sunk into the earth, and made firm in a hole opened by an iron crow, makes the best stool for a bee-hive. It is neither too rough, nor too cold; and the mice do not get up.'

4. *Galloway*,—comprehending the Counties of *Kirkcudbright* and *Wigton*.

1. *Cattle*—have been long the staple produce of these counties; and the breed is well known to be excellent. As a pretty full account of them has been given in the 14th Chapter itself, it is not necessary to enter into particulars here.—'The 'whole number of cattle sold annually, from Galloway, according to very accurate information, may be stated at 20,000. 'The proportion of bullocks is about two-thirds; the remainder 'are heifers, including a few cows.' Of this number, 2 or 3000 have been imported annually from the neighbouring counties, or from Ireland and the Highlands. The cattle sent to the Norfolk markets, which are of the best description, brought 13*l.* a-piece, at an average for two or three years preceding 1809; but about 3000 are sold in Dumfries, or sent to the North of England, which a-

verage only 8*l*., or 8*l*. 10s. A vast number of transfers are made among the farmers of these counties, independent of the sales for exportation—*Galloway Report*, p. 250. In this home-trade, the object is not so much to derive a profit for the food the cattle consume, while on the farms of their successive owners; as from the knowledge of the state of markets, and the ability to select the best stock, which the buyers and sellers respectively possess. It is thus, in many instances, a business but little connected with that of the farmer or grazier; and to the extent to which it is often carried, extremely inconsistent with the steady and regular profits of both. The introduction of Dairy husbandry into several parts of Wigtonshire, may probably diminish the number of the Galloways in a few years.

2. *Sheep*—are but little attended to on the low lands of Galloway; but on the mountainous parts they are very numerous. A few of the small dun-faced breed are yet to be found in Wigtonshire; and a variety of foreign breeds are kept in small numbers by proprietors; but the Black-faced, or Mountain breed, are in almost exclusive possession of all the higher grounds. They are of a smaller size than the Tweeddale, or Linton sheep. The trials made of the Cheviots are said not to have been successful; though it is admitted, that upon low-lying, and well-sheltered moor farms, the introduction of these sheep would be a material improvement.

3. *Horses*.—The ancient breed of Galloway horses is now almost lost, as farmers find it necessary to breed horses of a larger size, for the operations of modern husbandry. With this view, the mares of Galloway have been covered with stallions from England, and from Ayrshire. Few more are bred than are necessary to supply the demands of the district.

4. *Swine*.—The number in Galloway, is very considerable.—'From the best information that could be obtained, they amount 'to about 10,000, which will nearly give one for every family in 'the district.'—(*Galloway Report*, p. 295.) The most common variety, is a very bad one; but better breeds have been introduced into several parts. They are mostly sold to Dumfries-shire dealers, who cure them for the English markets.

There is an extensive rabbit-warren, near Glenluce, in Wigtonshire, the value of which is estimated at 400*l*. a-year. Pigeons and poultry obtain little notice. Bees are kept in considerable numbers, and the honey is of an excellent quality.

III. THE SOUTH-WESTERN DISTRICT.

1. *Ayrshire*.

1. *Cattle*.—The Dairy husbandry is here carried on to a great extent, but is chiefly confined to cheese-making. Mr Aiton, the

author of the County Report, guesses the total number of cattle at 42,360, of which at least 30,000 are dairy cows.

2. The *Sheep* of this county are not materially different from those of the contiguous counties of Wigton and Kirkcudbright.—The number has been stated at upwards of 310,000, which is more than that of any other county in Scotland. A few of different breeds are to be met with occasionally on the lower grounds; but the only sheep stocks that deserve the name, are kept on the hilly and mountainous parts of the county, and are of the Black-faced breed.

3. *Horses*.—In this, and the adjoining county of Lanark, a great number of horses are bred, and reared. The number in Ayrshire has been estimated at near 10,000.

4. *Swine*.—A considerable number of these are fed upon the offals of the dairy; but this branch has only been attended to of late; and it is not yet so general, or so systematically conducted, as in the dairy counties of England.

There are more *rabbits* in this county, than in any other county in Scotland, though they are said to have only been introduced into it in 1777. The breed is generally the grey rabbit; other varieties have been tried, but without success. Their food is chiefly the herbage which grows on the sandy knolls on the sea-shore, and the ground is seldom enclosed. The fur being the most valuable article, the rabbits are killed from the beginning of December, to the end of February, when it is of the greatest value. The skins sell at 15s. a dozen, and the carcases at about 10d. a pair.

Dunghill fowls are reared at almost every farm-house and cottage.—Other kinds of poultry, and pigeons, and bees, are not numerous.

2. *Renfrewshire.*

1. *Cattle*.—The dairy is a considerable object in this county, as well as in Ayrshire; and the produce is sent chiefly to Glasgow, Paisley, and Greenock, in butter and butter-milk, there being few cheese-dairies in the county. The number of cattle of all kinds in this county, is supposed to be about 10,000.

2. *Sheep*.—These are not numerous, and the flocks are generally small, and confined to the higher grounds. They are of the Black-faced breed; and the number has been estimated in the County Report at no more than that of cattle, or 10,000. Colonel Downie of Paisley, then in Spain, sent into this kingdom at Midsummer 1810, 1000 or 1200 pure Merino sheep; about one-half of which were landed in this county. Sir John Sinclair inspected this flock in August 1810, and drew up a communication to the Board of Agriculture regarding them, which has been already published. In the autumn, about 200 ewes and 50 rams were sold in small lots by auction; the former, on an average,

10*l*. each, and the latter at 15*l*. Some of the best rams were sold at 26 guineas, and the finest ewes brought 18*l*.

3. The *Horses* of this county are generally purchased from Lanarkshire and Ayrshire, few being bred in the county. The number paying taxes is 2234.

4. *Swine* are not generally reared, and but few are kept by farmers and cottagers.—A considerable number was fed at a starch-manufactory, near Paisley; but that work has been discontinued.

There are a few common fowls at almost every farm-house.—Turkeys, geese, and pigeons, are not numerous; and there are no rabbit-warrens in the county. The number of bee-hives has diminished of late years.

3. *Lanarkshire*, or *Clydesdale*.

1. *Cattle*.—' The number of oxen kept in this county, is inconsiderable. Exclusive of those which are casually brought in to fatten on the summer pastures, or on turnips, the whole perhaps does not exceed 200. Milch-cows, and young females rearing to supply them, are the principal stock. The whole may amount nearly to 30,000.'—(*Clydesdale Report*, p. 157.) These cows are of the Ayrshire breed; great numbers of them are kept in and near Glasgow, for supplying the inhabitants with sweet-milk, and butter and butter-milk. Some account of an extensive Dairy establishment near that city shall be given in a subsequent article of this Appendix.

2. *Sheep*.—These are confined to the higher grounds, and are of the Black-faced breed. A few of the Dishley variety may be found on the lower parts of the county; but neither here, nor in any of the western counties, has sheep-farming been combined with arable rotations, as in some of the south-eastern counties. The number is stated at more than 120,000.

3. *Horses*.—The best farm-horses of Scotland have their name from this county; and great numbers are sold at the markets of Lanark, and other places, for the supply of other districts. According to the County Report, the number employed in agriculture, with the young ones rearing on the different farms, amount altogether to about 8000. The number of horses kept for travelling, for carriage of goods, and for pleasure, is very considerable, but had not been ascertained by the Reporter.

Swine are scarcely an object of attention to the husbandmen of this county, at least not till very lately. There is but one rabbit warren; and the Reporter justly observes, ' that rabbit warrens, and the cultivation of a country for corn, seem to be somewhat incompatible.'—Geese and turkeys are bred mostly by people of fortune.—Dunghill fowls are, as usual, reared about every farm-yard.—There are not many bee-hives kept by farmers. ' The greatest part of the information got from bee-

'masters here, consisted of long accounts of their losses by the 'death of bees in bad years, and by the theft of hives in good 'ones.'—(*Rep.* p. 167.)

4. *Dumbartonshire.*

1. *Cattle.*—A small proportion only of the cattle of this county are bred in it; the greater part are bought at 2 or 3 years old, chiefly from the West Highlands, and partly sold again within the year to the Southern counties, and to England, and partly fattened. Of late some attention has been paid to dairy husbandry, for which cows are purchased from Ayrshire and Renfrewshire. According to the situation, the milk is sold as it comes from the cow, or converted into butter and butter-milk, or into butter and skim-milk cheese. The manufacture of sweet-milk cheese has been almost laid aside of late years. The number of cattle in this county, in 1811, is stated at 9120.

2. The *Sheep* are of the Black-faced or Mountain breed, said to have been brought from the counties of Dumfries and Lanark about the year 1750. The number at present is nearly 28,000, almost all of which are bred on the farms where they are kept.

3. The number of *Horses* bred in this county at present is very inconsiderable; they are of the Clydesdale breed; and the common practice is to purchase from Lanarkshire at 2 and 3 years old, and sell off at 5 or 6. There is said to be about 1500 horses in the county, of which more than two-thirds may be constantly employed in husbandry.

Pigs are kept in sufficient numbers for domestic use; but only a small proportion of their flesh comes to market. About 200 fallow deer occupy two of the largest islands of Lochlomond in this county. Poultry are not numerous. Bees afford a very precarious, and for the most part inconsiderable, return.

IV. The Central District.

1. *Fifeshire.*

1. *Cattle.*—The cattle of this county being of a breed somewhat distinct, have been described in the 14th chapter. According to the county Report, the number of cows, about the year 1796, was 10,000; and the whole stock of cattle, including such as were brought from other counties by graziers, might amount to, perhaps exceed, 60,000. By later information, the annual sales of the native breed of the county to other districts, are nearly 3000 cattle of all ages; of which only about 300 or 400 are cows or queys, which are chiefly sent to Mid Lothian. The others are steers or oxen, commonly of the age of 3 years; full aged oxen are no longer to be found here.

2. *Sheep* do not form an important portion of the live stock of this county. The flocks are not numerous, and the number of

each is commonly small. The ancient dun-faced breed is the prevalent one; it is confined to the higher grounds. Some Black-faced ewes are kept as a flying stock; and the lambs first, and then the ewes themselves, fattened in the course of the season. A few of other breeds may be found in the hands of proprietors, as in other counties; but their number is inconsiderable.

3. *Horses.*—These are not materially different from the horses of the Lothians. Breeding has been more attended to of late; but it is believed that the numbers bred are scarcely adequate to the supply of the county.

A great number of *Swine* are fattened by distillers. At corn-mills too they are numerous, and farmers and cottagers have one or more in almost every part of the county. *Rabbits* are bred in considerable numbers on the extensive links and sand-banks along the shore, but are not considered an object of importance. Poultry of all kinds much the same as in other counties. Pigeons were much complained of, but their numbers have been diminished. Bees are said to be seldom productive of much profit, and are but little attended to.

2. *Kinross-shire.*

3. *Clackmannanshire.*

1. *Cattle.*—The cattle stocks of these counties chiefly consist of the breeds of the adjacent districts of Perthshire and Fife-shire. In Kinross-shire about 900 are reared annually, and the ordinary stock is about 5400. At the distillery of Kilbagie in the county of Clackmannan, the number of cattle annually fed, previous to the year 1788, amounted to about 7000, and of swine to 2000. There were five other considerable distilleries in the county, where great numbers of both kinds of stock were fattened, but these have not been mentioned.—(*Kinross and Clackmannan Reports.*)

2. *Sheep.*—In neither of these counties are sheep very numerous. In Kinross-shire they are estimated at 6100, partly of the same breed as in Fifeshire, and partly of the Black-faced kind. In the county of Clackmannan, the number is stated at 7000 on the mountains, almost wholly of the Black-faced breed, and about 1000 on the lower grounds.

3. *Horses.*—In Kinross-shire, the number of horses of all descriptions is 1060, of which from 600 to 700 are employed in agriculture and the different labours of the county. More horses are reared than are required for supplying the stock. In the county of Clackmannan few horses are bred; they are mostly purchased from the western counties.

On all the great farms of the latter county a piggery forms an essential part of the establishment. The large Hampshire breed are preferred for the distilleries: that which is most esteemed among farmers is the Chinese. The district of the Ochills is singularly favourable for bees; yet it is difficult to say whether the profits afford a compensation for the expense and trouble.

4. *Stirlingshire.*

1. *Cattle.*—' Though some calves are reared upon almost every farm, yet this cannot properly be denominated a *breeding* county.' The grazing districts are chiefly occupied in fattening; and the cattle of the West Highlands are preferred to those bred within the county. The milk cows most esteemed are of the Ayrshire breed. The number of cattle has been stated in the late Report of the county at 19,225.

2. *Sheep.*—The breed that is almost universally kept here is the Black-faced. The Cheviot variety has been introduced lately. The total number is estimated at 37,977.

3. *Horses.*—Very few are bred within the county. Work horses are procured chiefly from the counties of Lanark and Ayr. The number of all kinds is stated to be 3565.

Swine are not numerous, unless at distilleries. The breed most esteemed by farmers is the Chinese, and the large Hampshire variety by distillers. A cross-breed between these two is held in great repute. On one of the islands of Lochlomond there are about 240 fallow deer. Goats were formerly numerous, but are now almost entirely exterminated.

5. *Perthshire.*

1. *Cattle.*—The native cows, in general, are of a bad breed. In the vicinity of Perth, and in the Carse of Gowrie, the farmers have introduced the Angus and Fife breeds. In the west they prefer the Argyleshire, and in other parts of this extensive county cows have been brought from Galloway and Ayrshire. Cows have been also introduced from Devonshire and Lancashire, besides a few of the Guernsey breed. A species from the East Indies, imported by Sir John MacGregor Murray, Bart. are thriving, and promise to do well.

2. *Sheep.*—The ancient White-faced breed which were found in every part of the Highlands not many years ago, and still exist in small numbers in most places of that district, have been almost entirely supplanted in Perthshire by the Black-faced or Mountain breed. The latter were introduced about 40 years ago, and occupy the higher grounds; while a few small flocks of different breeds are found as usual on the enclosed fields chiefly in the occupation of proprietors. The number of all kinds is stated at about 222,000.

3. The *Horses* of this county are of many different breeds and sizes, from the small Highland poney to the strong draught horses of the Carse of Gowrie. Oxen have never been worked in the Highlands; in the Carse of Gowrie they were laid aside more than 30 years ago.

4. *Swine.*—Great numbers of these are reared on some of the hilly districts of the county; and, besides supplying their own consumpt, the farmers bring down herds of thousands at a time to the markets of the low country. The breed which is most frequent, as being the most hardy, 'is what is called the Scotch 'sow, having long bristles, a long snout, long legs, the belly less 'pendulous, the back raised, and the ears less slouching than in 'the other breeds.'

There are still remains of the red-deer in this county. The roe-buck and doe are in almost every district which is not divested of wood. Fallow-deer are not numerous. According to the Reporter for this county, the consumpt of grain by pigeons over the whole of Great Britain, may be equal to the food of 120,000 persons. In the sheltered parts of the hilly country, bees are an object of great attention and profit. Poultry the same as in other counties.

6. *Angus*, or *Forfarshire*.

1. The *Cattle* of this, as of most other counties of Scotland, are partly bred and reared within it, and partly brought from other districts; the former may be called the *permanent*, and the latter the *flying* stock. The grazing and feeding of cattle are here prosecuted to a much greater extent than the rearing of them. For this purpose, great numbers are purchased from the counties of Mearns or Kincardine, Aberdeen and Moray. These cattle are either carried forward to the butcher, or sold in a half fat state for the Southern counties. The permanent stock is of various breeds; a great proportion have no horns, and in this particular seem allied to the Galloways. A few farmers have the short-horned or Teeswater breed, and others have tried the Guernsey; but the latter were thought too delicate for the climate. In former times, oxen were very generally worked in this county; but now they are seldom employed, except in ploughing land overrun with broom and shrubs. The permanent stock may amount to 37,400; of the flying stock no estimate has been made in the Report.

2. *Sheep.* About 50 years ago, almost every farmer had a flock of sheep, numerous in proportion to the extent of his farm; and they were pastured promiscuously on the waste land which abounded in every parish. But since these wastes were subjected to the plough, or planted, the sheep have been gradually banished to the mountainous districts of the county. The ancient small white or dun-faced breed is still to be found in some districts of the Grampians; but the breed which most generally prevails is the Black-faced or Tweedale. The number of all breeds and ages is stated at 60,000.

3. *Horses.* The ancient breed was the small *Garron*, which still keeps its ground in some parts of the Grampians. The Lanarkshire breed prevails very much in the Low country. The

total number may be about 9000; of which 5558 are supposed to be work horses of a full size, 2500 young ones, and such as are under 13 hands high, and 951 saddle horses. A sufficient number is not reared to keep up the stock of the county.

Swine are kept chiefly at mills and breweries. There are very few rabbits. Poultry are reared in considerable numbers; particularly dunghill fowls. Pigeons are numerous, and are supposed to consume their own weight of grain daily, besides what they destroy by treading. In this, as in every other county, the laws that protect this destructive race are the subject of general complaint. There are a great many bee-hives; but their produce is not so great as formerly.

V. THE NORTH-EAST LOWLANDS.

1. *Kincardineshire*, or *The Mearns*.

1. *Cattle*. The number of every description in the county at the time of writing the Report, was 24,825; which was almost precisely one beast for every three acres in cultivation. Of this number, 6236 were milk cows, from which 5280 calves were reared; and after allowing for losses, the number sold annually, at from two to five years old, may be about 5016, independent of the flying stocks bought in chiefly from Aberdeenshire. The colour most esteemed is black; and a large spreading head of horns is a great recommendation, because by this their breed is ascertained in the English markets. The value of the cattle on an average may be stated at about 6*l*. 8s. a-head, or 158,880*l*. in all. The value of those annually disposed of, including the increase upon those that are bought in from other places, will be about 58,395*l*. To this must be added the value of the dairy produce, amounting to 28,176*l*.; so that the yearly revenue arising from cattle is altogether 86,571*l*. It is much to be regretted that similar estimates have not been presented in most of the other county Reports.

2. *Sheep*. The number, exclusive of lambs, was ascertained, about Midsummer 1807, to be 24,957; of which about 21,500 were fed on the Grampians, and the remainder in the low part of the county. The small native breed still exists here; but the Black-faced heath breed are now more numerous. The prime cost of the whole sheep in the county may approach to 20,000*l*.; and the yearly produce to 10,480*l*.: a very small sum, considering that there are 120,000 acres of sheep walk in the county, besides the pastures of the cultivated land, of which sheep have also a share.

3. The *Horses* are of the Clydesdale breed, and the number reared is nearly sufficient for the supply of the county. Of all ages and descriptions there may be about 3587, valued at 71,740*l*.

Swine are not so numerous as they were formerly. Poultry are very abundant. Pigeons are not so plentiful as in the Lothians. Bees are a favourite stock with the tenants and country mechanics, but are attended to rather as an amusement than with a view to profit. One circumstance is worthy of remark, that a hive brought down from the hills to the low country or coast-side is always more industrious, and thrives better for a year or two than those hives that have been reared there.

2. *Aberdeenshire.*

1. *Cattle.* This county draws yearly for cattle, sent either to England or the South of Scotland, so large a sum as 150,000*l.* They are now in great repute in the English markets. Many of them, when fed in the county, reach 100 stones and upwards, the four quarters. The whole number is about 110,000, of which the cows are nearly 28,000. The total value of cattle killed in the county, and sold to other districts, may be estimated at 250,000*l.*; and of dairy produce 230,000*l.*; amounting together to 480,000*l.*, the annual revenue derived from cattle. The value of the whole stock, including the annual sales, is stated at nearly a million of pounds sterling. Oxen are still worked in this county; they perform only one yoking or journey daily, that is, they work only half the time that horses do. Upon large farms, two pairs of oxen are kept for one plough, and each pair works in rotation.

2. In this, as in the adjacent counties, *Sheep* are almost confined to the higher grounds. They are partly of the native breed, and partly Black-faced. The total number is less than that of black cattle, being about 100,000, which are valued at as many pounds. The number killed annually is worth nearly 30,000*l.*

3. *Horses* are of all sizes, from the Highland poney to the Clydesdale horse. In bartering horses with other counties, there is supposed to be a loss of 20,000*l.* annually. The number of work and saddle horses, per the Collector's books, amounts to 8605.

Swine are much diminished in number of late years, there not being above 1000 in the county. Poultry are very numerous; and the annual sales of them and their eggs, with the value of the home consumption, are supposed to amount to 20,000*l.* Bees, it is said, are too much neglected. 'The great objection to the keeping of bees is the expense of feeding them in an unfavourable spring. An ingenious friend of the Reporter's has contrived to keep them in an *ice-house* in a state of insensibility, which is *a saving of their winter provision.*' *Aberdeenshire Report*, p. 509.

3. *Banffshire.*

1. *Cattle.* The various breeds and crosses in this county have all nearly given way to the breed of the Isle of Skye, or what is generally called the true Highland breed, which are often brought to the weight of 50 or 60 stones. Almost in every quarter of the county, there are, on the larger farms, some pairs of oxen kept for the draught both of the plough and cart; but, compared with that of horses, their number is inconsiderable.

2. *Sheep* are an object but of secondary consideration, and are almost entirely banished from the arable land. The small White-faced, and the Heath or Tweeddale breeds, occupy the higher grounds.

3. *Horses* are of the same description in this as in the counties adjacent. There is a sufficient number of work-horses reared for the supply of the district.

Swine are reared for home consumpt chiefly; though a few are occasionally sent to Aberdeen. Of poultry, pigeons, and bees, the same account is given as in the Reports of most other counties.

4. *Elginshire*, or *Morayshire.*

5. *Nairnshire.*

1. The *Cattle* of these counties, like those of Banffshire, are mostly derived from the breed of the Isle of Skye, but raised to a greater size by better feeding. 'There are only a few pairs of 'worked oxen; and in an agricultural view, they are of little im-'portance.' The cattle are sold principally for the English markets in good grazing condition, the home consumption of beef being inconsiderable.

2. *Sheep.*—The ancient small breed, and the Black-faced, are the most numerous, though several other varieties have been introduced.

3. The *Horses* of these counties have been much improved of late; and very spirited attempts are making to render them still more valuable. They do not differ materially from the horses of the other counties in this district.

The original stock of swine is of a small size; but the Chinese and Berkshire breeds have been introduced, and are now more generally reared. The number of all kinds, however, is not considerable. With regard to common fowls, the following remarks extracted from the Report of these counties, may deserve the attention of such as rear this kind of stock to any extent.

'It is almost needless to observe, that both proprietors and larger farmers, with hardly any exception, maintain an establishment of this species of poultry, sufficient each for his own table. The public markets also are pretty well supplied, by the numbers reared for sale in the families of the smaller tenants, cottaers, and rural artisans. From the number of capons which appear in the old rentals, it might be inferred that our forefathers, more frugal than we, did not eat chickens, or that the capon was formerly an object of much more consideration than at present.

'Of this species of poultry there are, in this country, six varieties. The indigenous breed are hardy, easily fatted, and fully naturalized to the climate and the subsistence of the country. In the upland district, where this breed is yet uncrossed and pure, it resembles, in some respects, the common pheasant, and is superior in respect of delicacy at the table. To the pheasant it is doubtless nearly allied; or from them, there is reason to believe, that this breed may have originally sprung. Under the title of Hebrydal pheasant, Mr Latham describes a mixed breed between the pheasant and the cock. This gentleman also mentions that wild pheasants sometimes come into the farm yards, and generate a cross breed with the common hen.

'This valuable kind may be managed in such a manner as to breed twice in the year; and the hen, when properly kept, besides rearing both broods, will lay nearly 200 eggs.

'The second most valuable variety is distinguished by the name of the "Hamburgh breed." It has nearly all the good qualities of the indigenous race, except the glossy plumage which many individuals of that species possess, and that it cannot provide so effectually for its own subsistence; but it attains to a much larger size. It generally has five toes on each foot, is adorned by a ruff of feathers round the neck and ears, and is commonly of an unmixed, though not very bright, white colour.

'Although no species of gambling has been ever fashionable in the country, (in which it is believed that a cockpit was never formed), yet the game breed is a third variety, frequently to be seen in every quarter. They weigh about 4 lib.; but producing few eggs, and being delicate when young, they are not a profitable breed for farmers.

'A fourth variety, known by the name of the "Bantam breed," is distinguished by having the legs covered with feathers to the toes, which greatly incommode it when walking in snow, while any advantage of this distinguishing mark is not obvious. They weigh scarcely more than 2 lib.; but they produce a great number of small eggs.

'The fifth species is also a small breed, called the "French fowl," having the feathers partly erect, and for the greater part curled towards the head. Similar to the Bantam breed, they only weigh about two lib., and they produce a great number of eggs; but as they are very imperfectly protected by their plumage from the cold and from the rain, they are rather delicate for this severe climate.

'The sixth variety is peculiarly marked by having neither rump nor tail. They weigh more than either the Bantam or the French fowl, yet less than the natives: They lay however a greater number of eggs than any of the other kinds, the shape of which is globular, rather than what may be called the long oval.

'Although this kind of stock requires comparatively but little care, yet they will not thrive in a confined, damp, ill-aired, or in a very cold and exposed situation; neither will they thrive well in conjunction with turkeys, geese, guinea fowls, or ducks, nor without access to clean water, and to gravel. They rejoice in the warm shelter of a little grove, or strip of plantation. Their habitation also should be frequently cleaned, and it should be never crowded.*

'The young brood should be kept by themselves when under the care of the mother, and for some time after she leaves them. A bolus of butter and oatmeal, about the bulk of a pigeon's egg, given daily, will, in four or five days, cure the disorders to which they are in general subjected.

'In summer, with a little boiled potatoe, cabbage, or turnip, they will thrive on the grass, with the assistance of the worms, seeds, and insects which their own industry procures. In winter they require a little corn (oats or barley). To make a hen lay an egg daily, in that season, she must have a mess or two of warm oatmeal pottage, or of something warm and equally nutritive, besides the common feeding. A comfortable degree of warmth is also in such a degree essential, that some gentlemen, it is said, have placed a stove under their roost, gaining thereby the advantage of the experience of the poor widow, with her two hens and her cock, living almost over the fire of her little cottage.

'Fowls are not particular in the choice of their fare; it is probable that with their kindred the pheasants, they could make an occasional meal on carrion. The poultry of the fishing villages feed so much on the garbage to be found there, as to communicate a fishy flavour, nauseously disagreeable both to their eggs and to their flesh. Any kind of food, very much salted, is said to poison them. †

* The vivifying speck, without which the egg is unproductive, may be easily perceived in the sun beam, or between a candle and the eye; its situation on the *top* of the egg determines the chick to be a male; when on the *side*, it will certainly be a female: It is therefore easy to propagate either sex at pleasure, which, unless by the management of the bees among themselves, is not yet known to be the case, in any other class of the animal creation.

† M. De Reaumur, of the Royal Academy of Sciences of Paris, in the Memoirs for hatching poultry in ovens and by the heat of dung, has ascertained that giving one hen, in the yard, as much barley as she chooses to eat, she cannot consume more than two Winchester bushels in the year; that four measures of barley boiled till the husk split and burst, swelled so as to measure ten; and that *three* measures boiled in this manner, was, in the efficiency of feeding, equal

'To preserve eggs fresh, they are to be smeared over with butter, mutton suet, or lard, immediately on being taken from the nest; but the vivifying speck is thereby destroyed. This germ is presumed to be itself the principal cause of the corruption of the egg; for those laid by hens which have had no communication with the cock, have kept sound for several months without being any way smeared: the evaporation proceeded through the pores of the shell, the yolk became somewhat thickened, and the white part was considerably diminished.

'While a turkey sells for four or five shillings, the price of a hen is only one shilling and sixpence; chickens nearly half as much, and eggs about fourpence per dozen.—(*Report for Nairn and Moray, p. 335, et seq.*)

VI. The West Highlands.

1. *Argyleshire.*

1. The *Cattle* of this county have been described in the 14th Chapter, under the denomination of the West Highland breed. The chief object of the breeders, is to rear them for the southern markets. In the district of Kintyre, the dairy is more attended to than rearing.

2. *Sheep.*—These are chiefly of the Black-faced kind; though there still remains a good many of the ancient breed, which the Reporter thinks, probably with good reason, might have been so much improved with proper attention, as to have become a very suitable stock.

3. Many of the *Horses* of this county are of a size well adapted to the work they have to perform, where attention has been paid to the improvement of the native breed. But in other parts, they are too small and weak for a two-horse plough, and have been crossed with stallions from the Low country.

Swine abound most in the district of Kintyre. They are generally of a small, dunnish-white breed, with erect ears. The small black Chinese are much approved of. There is only one rabbit-warren in the county. Poultry, pigeons, and bees, are not numerous. Of goats, there were about 4500 at the date of the County Report. Their number was much greater before the introduction of sheep.

2. *Inverness-shire.*

1. *Cattle.*—The best stocks of this county are similar to the cattle of Argyleshire in every respect.—'As to the manage-

equal to *five* given dry in the natural state; that they prefer boiled grain to raw; that they discover no preference to barley, oats, or wheat; that they prefer either of these to rye: that a hen at large will find the half of her subsistence, in worms, insects, and grass, in which situation one bushel will maintain her through the year.

'ment,' says the Reporter of the County, 'my information was, 'that no more than one calf is commonly reared from the milk 'of two cows, when they are in the natural possession of the 'tacksman of a farm, and owner of the cattle: But in other ca-'ses, parcels of cows are frequently let out to *bow-men*, who get 'possession of the tacksman's farm, and of his stock of cattle. 'These bow-men are confidential married servants, who trade with 'this species of their master's property, upon stipulated condi-'tions. They are generally bound to produce one calf, and one 'stone of butter, and two stones of cheese annually, for every 'milk-cow entrusted to their management; or one calf, and 40s. 'or 50s., according to the quality of the cattle, as may be agreed 'on. All the surplus produce of the dairy is allowed for vic-'tuals and wages.'—(*Inverness-shire Report*, p. 249.)

2. *Sheep*.—The number of these is estimated at 50,000. The old indigenous sheep are still very numerous; but the Linton, or Black-faced breed, are the most prevalent. The Cheviot variety are gaining ground, owing to the superior value of their wool.

3. *Horses*.—These are much the same as in the other Highland counties: the small native race are reared, and worked by the lower class of farmers, while proprietors, and substantial farmers, purchase larger horses from the Lowland counties. The number of the native breed has decreased since the introduction of sheep.

Swine are not reared in great numbers. A regard to the preservation of woods, and the general prevalence of sheep, have greatly diminished the number of goats, of which there are still supposed to be from 4 to 5000 in the county. Their skins are manufactured into purses for Highland regiments, which has raised their value a little.

VII. The NORTH HIGHLANDS.

1. *Cromarty-shire.*

2. *Ross-shire.*

1. *Cattle*.—Very little attention is paid to breeding, except in the south-western parts. The pure West Highland breed is considered the most profitable stock for feeding. Some people have the Fife breed; some the Morayshire, and others a mixed breed.

2. The *Sheep* are for the most part either of the small native kind, or the Black-faced. A few of other breeds, and among the rest Merinos, have been introduced. Of the last breed, some notice will be taken in a subsequent article of this Appendix.

3. The best *Horses* are imported; but, of late, horses of a good description have been bred in the county.

None of the inferior species of live stock have obtained much attention in these counties.

3. *Sutherlandshire.*

1. *Cattle.*—The native breed of the higher parts of the county is small; but feed well, when brought to the pastures of the Low country. The best stocks are of the West Highland breed; and crosses between bulls from Argyleshire and Skye, and the native cows, have improved the cattle of different parts of the county. At Dunrobin, various breeds have been tried; but the native stock of the county, improved by judicious crossing, seems to answer best.

2. *Sheep.*—The ancient breed was almost exterminated by disease in 1807. A few years ago, the Black-faced were introduced, and, more lately, large flocks of the Cheviot variety were established in this county, by farmers from Roxburghshire and Northumberland. Owing to the superior value of their wool, these seem now to be preferred to the Black-faced.

3. *Horses.*—Except upon the coast-side farms, the horses are small. The native breed of *garrons* are used for the plough, four abreast; and in some cases, three abreast, with a driver.—Four of these garrons are generally kept to plough from 8 to 10 acres of arable land; and where lots are smaller, two tenants join in the ploughing, each providing two garrons.

4. *Caithness-shire.*

1. *Cattle.*—Until within the last 20 or 30 years, the Caithness breed of cattle were considered inferior, in proportion to their size, to the cattle of almost any other county of Scotland, being of a thin lank make, and slow feeders, when brought to the pastures of the South. Since that time, considerable improvement has been made by means of the West Highland breed, bulls of which have been introduced by several proprietors. The great distance from the Southern markets, has occasioned less attention to be paid to breeding in this county, than in most others.

2. *Sheep.*—Until about 20 or 24 years ago, the only breed was the native White or Dun-faced. In 1792, SIR JOHN SINCLAIR brought 500 ewes from the Cheviot Hills, which had increased to 3000 in 1800. They are not found too delicate for the climate, and the example of the Patriotic Baronet has since been followed by others. The Black-faced breed had been settled on another gentleman's estate; but was afterwards supplanted by the Cheviots, when Sir John Sinclair's flock was found to succeed so well.

3. *Horses.*—A middle-sized description of horses have been introduced and reared on a few farms, but the general stock of the county consists of the small Highland garron.

Little attention is paid to swine. There are rabbits on the sandy links; but the rent paid for their pasture is but trifling.

Turkies have been reared of late years; and for rearing geese, this county, it is said, has from time immemorial been reckoned the best in Scotland. The climate is too cold for bees.

VIII. The HEBRIDES or WESTERN ISLANDS.

1. The *Cattle* of these Islands have been noticed in describing the West Highland breed in the Fourteenth Chapter itself. Of these there are about 110,000 in the Hebrides, exclusive of the Isles of Bute and Arran, and one-fifth of this number are annually exported to the British Continent, and fetch, at a moderate average, *5l.* each, or 110,000*l.*, which is somewhat more than the present rental of the Isles. Cattle are never employed in either ploughing or carting.

2. *Sheep* were little attended to till lately. The most numerous is the native aboriginal breed; next in point of numbers is the Linton or Black-faced; and the Cheviot breed has been now introduced into several of the Islands.

3. *Horses.*—Excepting in Islay, and on a few gentlemens' farms, not exceeding two dozen in number in all the Hebrides, (not including the two isles above mentioned, which compose the county of Bute), very little has hitherto been done for bringing the native breed to perfection, or preventing it from degenerating. But in Islay the garrons have been raised to the height of 13 or 14 hands, and are found to answer for the plough, cart, and saddle. None of the Islands except Islay, export, at an average of ten years, more than they import.

Swine are now reared in considerable numbers, the ancient prejudice against pork having gradually given way. The Hebridian sow of Arran and Mull seems to be either a lineal descendant of the Caledonian wild boar, or a cross between him and the long domesticated sow of Ireland, and is, in every point of view, an ineligible and worthless breed. Better kinds have been lately introduced into the Southern Isles. There are two rabbit-warrens, one of which pays 270*l.* of rent, and the other 35*l.* Poultry are not numerous. Goats still maintain their ground on several Islands.

IX. THE NORTHERN ISLANDS,

Comprehending the Orkney and Shetland Isles.

1. The *Cattle* of these Isles are of a very diminutive size, and of various colours; though it is observed by the Reporter, that the Orkneys are capable of rearing and feeding large cattle, provided due care were employed to raise succulent food for their support through the year. Should a market not be found for fat cattle either in a living or dead state, the dairy husbandry might be introduced with every prospect of advantage.

2. *Sheep.*—Of these there is supposed to be about 50,000 in the Orkney Isles; but very little revenue is derived from them,

owing to extreme mismanagement, as has been already noticed in the Fourteenth Chapter. The Spanish sheep introduced into these Islands by Mr Malcolm Laing shall be noticed in a subsequent article of this Appendix.

3. *Horses.*—The horses now generally used in Orkney appear to be descended from those in the Northern counties of Scotland. The common custom is to bring them from Caithness or Sutherland when a year old, and to sell a part of them again at reduced prices to the same people as they advance in years.

4. The *Swine* are different from those of the other parts of Scotland; of a small size, generally of a black or reddish colour, and of bad shapes. Their flesh is much esteemed for its delicacy and flavour. In summer they are sent to the hills; and in winter they roam at large over the arable land, and are very mischievous in both situations.

Rabbits are very plentiful in most of these Islands. From the Statistical Account of the parish of Stromness, it appears that no fewer than 36,000 rabbit-skins were shipped at that port in 1792. Poultry of all kinds are reared every where in Orkney, geese in particular. From the port just mentioned, 4424 lib. of feathers, 240 smoked geese, and ten barrels of salted geese, were exported in the same year. There are no bee-hives in these Islands.

Chap. XIV. App. No. 2.

Some Particulars of an extensive Dairy at Willowbank, near Glasgow.

Collected from the Communications of Mr William Harley, the Proprietor.

The commencement of this Dairy arose from an incidental circumstance. The proprietor had erected an extensive establishment of hot and cold baths, (which were much wanted by the community, none having been in the city of Glasgow before), and some invalids who attended them, expressed a wish to have warm milk after the bath.

The proprietor sent one of the cows from his villa to be milked at the baths. This was no sooner known, than there was a crowd from the city waiting for the milking of the cow, which led to inquiries, the result of which was, that Glasgow (as well as many other towns) had a *scanty* supply of *new* milk, the *quality inferior*, and the dealers had *no fixed measure* to sell by. It was therefore deemed of great importance to increase the *quantity* of milk, and at the same time to give the *quality genuine*, and by a *standard measure*. As the projector had an extensive manufacturing concern, besides the newly erected baths, and some other smaller matters to attend to, many difficulties stood in the way of his engaging with a dairy; especially as he had resolved, not only to have the milk given *entire*, but also to have the *cowhouse*, *cows*, and *milk kept* in a *more cleanly state* than by the usual mode.

These objects have been at last attained; and the system is now carried on with ease and advantage; and the citizens, *during winter*, have *genuine* new milk at sixpence a Scotch pint, or threepence a quart.

The cowhouse is fitted up upon a new construction. The cattle stand in rows, twelve in a row across the house, head and head, and tail and tail, alternately.

There is a passage behind for cleaning, and one in front for feeding.

There is a wire grating hung as a window sash in front of each cow, which lifts up when giving the soft food and cleaning the cribs, and is put down when they get hay, &c.

The contrivance for washing the cribs, collecting the urine, ventilating the house, &c. &c. gives peculiar advantages to the establishment, which may be summed up in the following items.

The health of the cattle.

The preservation of the timbers.

The diminished danger from fire, there being no hay-loft above the cattle.

The preservation of the provender. And

The flavour of the milk.

The heat is regulated by thermometers. A circulation of air can be produced, so as to keep the cattle comfortable in the *hottest* weather, by which their health is promoted. The ventilation also prevents the *timbers* from *rotting*; makes the cows eat their fodder better, as their breath is allowed to escape, instead of being thrown back upon the food, as is the case when their heads are placed opposite a wall.

It is well known that milk easily takes a taste from any other substance; of course, if the cowhouse is filled with bad air, the milk, while passing from the teat to the pail, and during the time it may stand in the house, will be impregnated with the foul atmosphere.

Mr Harley has made many experiments in feeding and preparing the food: and by the mode he now follows, the cattle *fatten* and *milk better*, than by the ordinary process; and the milk has *no taste* from turnips or other vegetables.

The arrangement for milking insures the cows to be *clean milked*, and also prevents *fraud*; and the mode of *locking up the milk*, and at same time of *admitting air*, *prevents adulteration* by the retailer. The cows are not farmed out to milkmen as in London.

The average stock, for some time back, has been 120 milk ıveraging five or six Scotch pints each per day, or eleven ı quarts overhead ; but both quality and quantity depend ıpon the kind of food.

n there is more new milk at any time than supplies the l, part is put in the milk-house till next day, when the d milk is sold at half price (for which there is a great l), and the cream sold at 3s. per Scotch pint. When any s left, it is put in a churn and made into butter, once a r fortnight. Mr Harley gives a decided preference to the e breed of cows. They are bought chiefly at country

ı regard to food; during summer the cows are chiefly fed t grass and green barley mixed with old hay; and during Mr Harley uses a good many turnips and potatoes, all h are steamed, and mixed with cut hay and straw; also ıd distillery wash, when these can be got.

cows are bought in generally either newly calfed, or a eks before calfing, and never turned out till they go to cher.

ble of regulations has been adopted for the times of feed-ilking, currying the cattle, cleaning the house, &c. &c. erson has a currycomb and haircloth for cleaning the cows day, a mop and pail for the house, which is washed and twice a day.

following abstract will show the advantage of this system owner of the cattle; but the benefit of a liberal supply of milk to the community at large, particularly to *children*, t easy to estimate.

cleanly state of the cattle and house makes it a treat for to see the establishment; and the way the vessels and ıuse are kept, have made some people fond of milk who y were disgusted at it, from the manner in which many airies are conducted.

advantage of irrigating grass lands with the cows' urine, exceeds belief. Last season some small fields were cut es, averaging fifteen inches in length at each cutting, and ırd very thick. The soap-suds of a public washing-house ılied to the same purpose with considerable advantage.

Harley sums up the advantages of his management in the ıg manner.

general health of the cattle by ventilation prevention of a disease called grainsick-, when fed on grains - - - prevention of swelling, by eating young wet grass - - - - -	15 per cent.*

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* Harley has not had a single cow *injured* in any of these ways since nencement of the establishment.

To prevention of choaking, when feeding on turnips or potatoes, &c. &c. - - -	15 per cent.
To saving in the expense of feeding, by improved modes of cooking, &c. - - -	20 do.
To saving of labour in feeding, dunging, &c. 50 per cent., as one person will do as much as two on the old plan; but allow 25 of this for cleaning, &c. leaves 25 per cent. profit on servants' wages - - - - - -	25 do.
To saving of timbers in the building, as they will last more than double the time - -	50 do.

Mr Harley has a steam-engine for driving the following machinery.

A small thrashing-mill.
A straw-cutter.
A turnip and potato-slicer.
The churning apparatus.
Pumping water, &c.

The same boiler that drives the engine steams the food, warms water, &c.

Such is the nature of this excellent system, the details of which Mr Harley would communicate to the public, if he were to receive that public remuneration to which he considers himself justly entitled.

After much study, labour and expense, the establishment is now brought to such a state of perfection, that it receives the cordial approbation of all who have seen it, furnishing the community with genuine milk at comparatively a low price. It is admitted, that the greater part of the system is original, and is not to be met with in any other part of the kingdom.

If the scheme yields, on the whole, a fair profit, it may be said that is a sufficient reward; but to this it may be answered, that the establishment has cost the person who undertook it a *great deal of trouble and extra expense*, which would be saved to any other individual who might now adopt his improvements. Indeed, if a plan, and a minute description of the system, were given, it could easily be adopted, to much advantage, in every town in the kingdom. The great savings that would thence arise to the proprietors of cattle, would be clearly demonstrated: but the benefit which the community at large would derive from this system, is of much greater importance. Milk being the *natural* aliment for children, it can hardly be questioned, that many lives are annually lost to the nation for want of that most nourishing diet; and if London, and the other large towns in the kingdom, could be supplied with milk genuine from the cow, as the citizens of Glasgow now are, the advantages would be incalculable.

Chap. XIV. App. No. 3.

Notices regarding the Merino Sheep in Scotland.

The first importation of these sheep into Britain took place in March 1788, when his Majesty obtained a small flock by way of Portugal. In 1791, another and a better variety was procured directly from Spain, which laid the foundation of that improvement in the quality of British wool, which has of late engaged so much attention in England. In the same year, Sir John Sinclair, with that patriotic energy by which he has always been so eminently distinguished, procured 10 rams and 5 ewes from the flocks of the King of France, from M. D'Aubenton, for the British Wool Society, of which he was the Founder. It was not, however, till 1804, when his Majesty's annual sales commenced, that these sheep attracted much notice, or were widely spread over the country. Since that time, many successful experiments have been made in England, in improving their carcase; and the fleece of some of the native breeds, has, by means of crossing with Merino rams, been brought to a degree of fineness very little if at all inferior to that of the pure Merinos.

The soil and climate of Scotland, and its system of rural economy, so different in many respects from that of England, sufficiently account for the little progress the Merinos have made in the former country. The first property required in the sheep stocks of our mountains is a degree of hardiness, which nothing but long experience can warrant us to expect in the natives of a much warmer climate, and of much finer pastures; and at least two-thirds of the surface of Scotland consist of such exposed and barren tracts. On the lower grounds, where convertible husbandry almost universally prevails, sheep are not kept in great numbers, and often only for a part of the year; a ready supply being always obtained from the higher grounds. When permanent stocks are found profitable on arable land farms, it becomes necessary to choose a quiet and highly domesticated breed, while fences continue so insufficient as they still are in several districts. Besides, while the price of wool is ever fluctuating according to the state of our foreign relations, that of butcher-meat has been steadily advancing for many years past, and at the present time probably gives a better return to the farmer than even wheat. Unless, therefore, a fine fleece can be combined with a quick-feeding carcase, which, from the great portion of yolk that seems necessary to the growth of fine wool, does not appear highly probable, it is hardly to be expected that the Merinos or their crosses will soon become a favourite stock on the arable lands of Scotland.

There are a few intermediate situations, however, in which it seems desirable that these sheep should be fairly tried. Several counties contain both hills and plains; and where these different descriptions of surface approach each other by slow and sometimes almost imperceptible gradations, there is a certain space too elevated for tillage rotations, and yet very susceptible of being occasionally cultivated for the amelioration of the pasture, and for raising winter food for live-stock. Such land at present is chiefly occupied either by sheep of the Cheviot breed, or of a mixed breed between Cheviots and Leicesters. Even on higher situations, where pure Merinos might be found too delicate, it might be adviseable, with a view to the improvement of wool, to employ rams that have a greater or less portion of Merino blood; or to put a few of the Cheviot ewes to a pure Merino ram, for the purpose of breeding rams for the future service of the whole flock. There seems the less danger in such an experiment, that a cross-bred race, with wool nearly as fine as that of the Merino, and of several different degrees less fine, have become habituated to the climate of England, and might be easily procured by the farmers of Scotland; and the carcase of these sheep is not nearly so objectionable as that of the pure Merino. It must afford a strong inducement to such experiments, to know, that a cross between Merinos and Cheviots, has been already found highly advantageous in Scotland, even on pastures of an inferior description, and in pretty high and exposed situations. In order to ascertain this point, queries were transmitted by the President of the Board of Agriculture, to several gentlemen who are making trials of the Merinos and their crosses; and from their answers the following short notices have been chiefly collected.

In Ross-shire, one of the most northerly counties of Scotland, Sir George Stewart Mackenzie and Mr Macleod of Geanies have crossed the Cheviots with Merino rams for several years. Some of the rams were purchased from his Majesty's flocks, and others reared on these gentlemen's farms. 'They were never allowed 'to go even into an open cot for shelter, and they have withstood 'the most severe weather.'—(*Treatise on Sheep by Sir G. S. Mackenzie*, p. 179.) In 1809, Sir George sold his Cheviot wool at 30s. per stone of 24 lib., and his Merino Cheviot at 44s.

General Robertson of Lude, in Perthshire, has tried the Merinos in almost every different way since 1804; and he has found the Cheviot cross turn out in every different shape of produce—in wool, carcase, and hardiness, better than the Ryeland, the Southdown, the Black-faced, or the Leicester crosses. The General bargained with one of his tenants, who has an excellent Cheviot flock, to give a portion of his best ewes to a Merino ram, and agreed to pay him at the rate of 18s. for each lamb of that cross, which was pastured on the same grounds with his pure Cheviot lambs, and delivered on being weaned in July. A Cheviot ewe, he observes, having from 2 to 3 lib. of wool only, her half Merino lamb will have double that quantity, and of double the value, when it becomes a two-shear sheep. On General Robertson's farm, a large flock of the Black-faced breed was kept in 1804; but the higher price of the Cheviot wool induced him gradually to change them by crossing first with the Cheviots, and afterwards with the Merinos, a few of which he introduced about the same time. A part of the Black-faced, and also of the Cheviots, were preserved free from crossing, for the purpose of ascertaining their comparative hardiness; and this gentleman declares, after a trial of nine years, that 'he had found the Merino 'and Cheviot cross-breed equally hardy and thriving as lambs, 'hogs and sheep, as the Linton or any other breed whatever.'

In the remote Orkney Isles, Malcolm Laing, Esq. has, in a flock of 1200 sheep, 260 Merinos, about 600 Merino-Cheviots, and the remainder chiefly Merino-Orkneys. Mr Laing uses no sheds; and after the first fortnight he finds the Merino lambs equally hardy with the Cheviot. He has therefore resolved to have nothing but Merinos a few years hence. In 1813, the Merino fleeces weighed at an average 4½ lib. though some of the sheep were 8 or 10 years old, and produced only 2 lib. a-head; the Merino-Cheviots, 3 lib. 7 oz. and the Merino-Orkneys 3 lib. 6 oz.

Besides these instances, there are several other flocks, more or less pure, in different parts of Scotland, of which no particular account has been obtained. Colonel (now General) Downie's sales in 1810, noticed in the first number of this Appendix, have placed these sheep in the hands of a number of proprietors; and from any information that has been procured, the result of their experience is not different from what has been already stated.

CHAP. XIV. APP. No. 4.

The following TABLE *of the* LIVE STOCK *of* SCOTLAND *has been compiled from the Reports of the different Counties; and, when these did not afford data, from the Statistical Account. As the Numbers vary even from year to year, the following enumeration does not pretend to accuracy, but gives merely an approximation.*

		Horses.	Cattle.	Sheep.
I. Arable District, or S.E. Lowlands.	Roxburgh - -	4,996	14,483	266,370
	Berwick - -	4,928	16,448	133,824
	Haddington, or East-Lothian - -	8,000	9,720	41,250
	Edinburgh, or Mid-Lothian - -	6,800	11,820	72,000
	Linlithgow, or West-Lothian - -	2,496	8,500	3,633
	Carry over -	27,220	60,971	517,077

		Horses.	Cattle.	Shee
	Brought over	27,220	60,971	517,
II. Southern, or Pastoral District.	Peebles	1,126	5,060	112,
	Selkirk	554	1,810	112,
	Dumfries	8,000	42,252	200,
	Kirkcudbright, Wigton } Galloway	9,845	80,000	204,
III. South-west Lowlands.	Ayr	9,888	58,384	313,
	Renfrew	3,378	10,000	10,
	Lanark	12,500	30,000	122,
	Dunbarton	1,500	9,120	28,
IV. Central District.	Fife	12,800	60,000	25,
	Kinross	1,060	5,400	6,
	Clackmannan	1,125	1,390	8,
	Stirling	3,565	19,225	37,
	Perth	15,976	79,089	222,
	Forfar, or Angus	9,000	45,400	60,
V. North-east Lowlands.	Kincardine, or Mearns	3,587	24,825	24,
	Aberdeen	21,448	110,000	100,
	Elgin, or Moray	5,410	16,900	36,
	Banff	8,400	24,764	58,
	Nairn	1,640	6,110	12,
VI. West Highlands.	Argyle	9,409	64,832	278,
	Inverness	11,159	42,016	50,
VII. North Highlands.	Cromarty	1,736	3,477	5,
	Ross	10,895	41,957	45,
	Sutherland	7,736	24,827	37,
	Caithness	5,232	14,833	12,
VIII.	Hebrides, or Western Islands	20,000	120,000	104,
IX.	Orkney and Shetland Islands	19,300	44,500	108,
	Total	243,489	1,047,142	2,851,

CHAPTER XV.

Appendix.

On the Price of Products, compared with the Expense of raising them.

It is propofed, here, to give fome general idea of the value or price of particular products, and of the expenfe of raifing them, at different periods.

At the acceffion of his prefent Majefty, the money price of all the kinds of labour employed in Scottifh agriculture, was not one-third, in many diftricts not one-fourth part, of its prefent amount. In the Southern counties, both the wages and maintenance of farm-fervants did not exceed ten pounds a-year; and a day labourer could earn only from 8d, to 10d. (rarely 1s.) a-day, according to his ftrength or dexterity in working, and to the different feafons of the year. In the middle divifion of Scotland, farm fervants, at an average, did not draw eight pounds a-year, feldom above feven, for both their fee and maintenance; and in the Northern counties and iflands, both thefe articles feldom exceeded five pounds. Day labourers, in the middle divifion, were not regularly employed; and their whole wages were from 5d. to 7d., rarely 8d. a-day. Lime was little ufed as a manure, and did not coft above a fourth part of its prefent price. Street and farm dung (when fold, which happened but feldom) did not yield one-fixth part; feldom amounted to an eighth of the fum at which a farmer is now eager to purchafe them. That of farm utenfils, from the low price of wood and iron, and the fmall wages paid to the artificers employed, was not an eighth part of their prefent money price, at an average of Scotland; and fuppofing them to have been as good as they are at prefent, would not have exceeded one-fourth of their prefent amount. The capital of a farmer, who rented a given extent of arable land, (fuppofe 100 acres) in the way in which he ftocked his farm, with horfes, black cattle, and fheep, (for he generally raifed all the three kinds of live ftock), feldom exceeded an eighth part of the value of its prefent amount; and if he had poffeffed the fame live ftock and other articles, would alfo have been below a fifth of the nominal value for which he could now fell it. But the real price of labour, and of all commodities, is different from their money price; the value of all human property is *relative* and variable; and by the *increase of skill and industry*, and the higher reward, or *real* price of labour, notwithftanding the depreciation of money, the farmers, (though they pay three, four, five, nay, in many cafes fix times as much rent as formerly), with their servants, labourers, and even their domesticated animals, now live much more comfortably than they did 50 years ago.

In the course of the last 20 years, or from 1794 to 1813 inclusive, the value of money has decreased, or the price of all commodities increased so rapidly, and there has been so great a proportion of that period, (viz. five years), when, from unfavourable seasons, bad seed, and unproductive crops, the money price of all farm products has been so high, that it would be necessary to fix upon a particular farm, and a particular year, nay, even a particular price, at which the products of a farm were sold at an average during that year, before we could accurately compare the expense of raising with the price of products. The value of the manure laid on the soil in every rotation of cropping, the quantity exhausted, and the quantity yielded by each particular crop, must also be taken into the account, before we could state, with any pretensions to accuracy, the expense of raising, and the price of products, even on that contracted scale.

It is to be observed, however, that the raising of corn is a species of rural manufacture, and the rearing of cattle is an article of internal commerce;—that the money price of the produce of the soil depends in no small degree on the demand for it by the manufacturers, and persons engaged in commerce of another description;—that there is not only a competition between the farmer and the grazier, but between the price of labour paid to the manufacturer and that paid to the farm-servant or labourer. These things occasion a great difference in the expense of raising farm produce, and require a higher price to be paid for the latter. And though, in this place, we cannot enter on minute calculations, it may be useful to place a few general results of calculation before the eye of the reader.

An acre of turnips cannot now be raised under 5*l.*, nor an acre of potatoes under 9*l.* more than the rent paid to the landlord, supposing the dung to be brought from, and restored to the farm.

A boll of oatmeal cannot, at the present rates of rent and labour, be sold with safety to the grower, in 1814, under 24s. at an average; nor a quarter of oats under 30s.

A quarter of barley cannot be afforded under 40s.; nor a quarter of wheat under more than double that sum. Nor can a fat bullock be sold under 3*l.* per cwt.

An unfavourable season will increase the money price of the products, and a very favourable one will occasion a decrease of that price. But the above may be stated as a fair general average, at the present value of money, labour, and land rents, in 1814.

CHAPTER XVI.

APPENDIX, No. 1.

ON POLITICAL ECONOMY:—OR THOSE CIRCUMSTANCES CONNECTED WITH THE IMPROVEMENT OF A COUNTRY, WHICH DEPEND ON LEGISLATIVE AUTHORITY, OR PUBLIC ENCOURAGEMENT.

By the Rev. CHARLES FINDLATER, Minister of Newlands, in Peebles-shire.

Preliminary Observations.

THE legitimate object of the fcience of Political Economy is, to inveftigate the fources of human happpinefs, and of national profperity, in fo far as thefe confift in the poffeffion of an abundance of the neceffaries, the conveniencies, and the comforts of life.

The fum of human happinefs which exifts in any given territory, muft be eftimated by the extent of population which it can maintain in a ftate of comfortable fubfiftence. The extent of population which can thus be fupported, depends upon the progreffive improvement of agriculture, and the other ufeful arts; and their improvement is the joint refult of *stock*, of *skill*, and of *industry*, all of which are mutually dependent upon, and fubfervient to each other. If thefe are protected in their operations by a wife and juft government, their natural tendency is, to carry civilization and political profperity to their higheft pitch; a tendency which nothing is likely to difturb, unlefs fuch undue fcope fhould be given to the powers of propagation, as fhould multiply population beyond all poffible means of comfortable fubfiftence,—a fituation which it is at all times within the compafs of thefe powers very fpeedily to produce.

Stock is created by man, out of the favings of the product of his induftry. A certain degree of fuch accumulation, were it but merely of the acquifitions of the chafe, is indifpenfable to that leifure and refpite from inceffant bodily fatigue, in acquiring the neceffaries of life, which allows time for the exertion of the intellectual powers, and for fupplying interim fubfiftence; till thofe plans are carried into effect, which infer, not only leifure and fkill in their contrivance, but the application, for a confiderable length of time, of means in themfelves not immediately profitable, before the profitable refult is obtained.

Skill is attained by man, in consequence of such leisure for the exercise of intellect, from experience and information, from judgment and inference. His animal frame is wonderfully adapted to the execution of his contrivances, the human hand being an excellent minister to the human head. *Dexterity* in operation is acquired through habit, in the course of frequent repetition; and it attains to its highest excellence, through that exclusive application of talent to one occupation which both leads to, and is dependent upon, that subdivision of labour which ensues from the universal propensity to exchange what is possessed in superabundance, against what is considered as more necessary.

In proportion to the dexterity thus acquired, through the exclusive appropriation of talent to one employment, labour becomes incalculably more productive; and, in proportion to the extent of the facility of exchange, so much greater is the encouragement to that still farther subdivision of labour, which tends more and more to augment every species of production.

When labour is thus rendered so superiorly productive, the labours of a few suffice for the subsistence of many. With less labour in production, more produce may be saved from immediate consumption. Stock can therefore increase; and with it, more leisure for contemplation, and the realization of its subjects:* Room is afforded for the cultivation of the arts and sciences; for the invention of machinery, and the discovery of other natural powers, and their successful application to the facilitating and abridgment of labour, by which its productive powers may be indefinitely increased; for improving and extending the means of intercourse and exchange—by improvement of navigation—or by canals, paved roads, and iron rail-ways, through which means are procured, artificially, to inland countries, those advantages possessed from nature, which have generally enabled countries,

* 'In the first stages of civilization, the labour of each individual is barely 'sufficient to procure a scanty and precarious subsistence for himself; and circumstances so adverse, not only form a bar to the introduction of other arts, 'but also chill and render torpid every faculty of the human mind. When these 'faculties are blunted by the cravings of nature, and wasted by the exercise of 'corporeal employment, man discovers few of those rational powers by which he 'is distinguished in the more advanced stages of society. It is only in situations 'where the means of subsistence are ample, where the labour of a certain part of 'the community is sufficient to provide the necessaries of life for the whole, and 'where a considerable proportion of the remaining population is placed beyond 'the necessity of manual labour to procure these necessaries, that the powers of 'the mind develop themselves, and show what man is really capable of performing. Hence, since the art of agriculture came to be so well understood, and 'subsistence, of course, to be secured to mankind, without the necessity of 'bodily labour from all, the mind of man has expanded, other arts and sciences 'have been successfully cultivated, and man, from being not much above the 'irrational animals, now fills a dignified place in the scale of created beings.'—*Treatise of Rural Affairs, by Robert Brown, Farmer at Markle, county of Haddington*, vol. I. Introd. p. 4.

situated on the shores of inland seas, or the banks of navigable lakes and rivers, to attain to the benefits of a more early and a more extended civilization. To the same head, of facility of intercourse and exchange, may be referred the common consent of holding money as the common measure of value, and bills of exchange as the representatives of money; together with the separate profession of the banker;—the origin of the distinct professions of the wholesale and retail merchants; whether stationary with their wares in their shops and warehouses, or ambulatory in caravans; whether attending fairs, or traversing the country as solitary pedlars. All these facilities spring up of course, as there is a demand for them; and, in general, are the proper subjects of private enterprise, rather than of public institution.

Industry is the unremitting and strenuous application of skill, dexterity, and stock, to their proper profitable occupation. It implies the existence of each, to a certain degree, and augments the quantity of both. Its appropriate excitement is found in man's wants and desires, joined to the certain prospect of applying its fruits to their relief and gratification. On particular occasions, it may be awakened to strong exertion by his benevolence;—but though this motive in the case of his descendants, (whom he identifies in a manner with his own existence), always acts strongly, and almost uniformly, and occasionally in other cases shows considerable force; yet, in general, it is a motive of much less energy, or, at least, by no means to be depended upon, for such unvarying constancy in its operation, as his selfishness.

A *right of property*, therefore, or an exclusive title to the possession, use, and enjoyment of the subject, to which his industry has been attached, must be secured to him, that his industry may be excited by its proper motive; for, as it is not given to man to create, his industry can produce no new existence of substance, but merely some modification of the form of what previously existed. But the form cannot be presented to him in an abstract shape, detached from the subject. A right of property, therefore, to the form (the product of his industry) must imply in it, as indispensable to its existence, a right to the subject in concrete with its modifications; at least, to such extent as is necessary to admit of these modifications being used and enjoyed. Indeed, in many instances, the industry of man can extend no farther than to the mere *occupation* of the subject, under the riginal form in which it is presented by nature.

That the savage may be excited, even to the simplest of all modes of industry, that of mere *occupation*, in collecting natural produce; the laws of his tribe must ascertain to him the property of what he has individually collected, or of his proportional share, where it hath been a business of cooperation,—of the apple he has plucked, or the root he has dug up,—or of his proportion of the game or fish obtained in a common hunting or fishing. If he fashions an utensil or weapon, of wood or of stone, he must be held proprietor of the materials, that he may enjoy the use of his manufacture: If, instead of persecuting the wild animals, to the risk of extermination, by hunting, to acquire a very precarious livelihood, he endeavours to secure a more certain means of subsistence, by protecting and multiplying the more useful kinds, in a state of domestication, he must be held proprietor of the animals so tamed or reared, without which he could reap no reward of his care and skill. His right must even be held to extend to *property in land;* at least, in so far as this is necessary for the subsistence of these animals, in affording them summer's herbage, and winter's fodder. If, to secure still farther a certainty and abundance of subsistence, he proceeds to cultivate the ground, he must be assured of the property of the soil, for at least such a length of time as is necessary for reaping the crop, else he could have no rational inducement to till or to sow.

The right of property is thus gradually extended, to suit the views of extending industry, till it reaches to the land itself; whether, as held in common, by a community or nation; or as held in severalty, by individuals—the mode of holding, which, evolving views of utility have universally pointed out, as most encouraging to industry.

Man exhibits indications of his destination to immortality, in the lively interest he feels in events that cannot ensue till after the termination of his mortal life. Were it not for this, it were impossible that he should make any difference in his estimation betwixt a perpetual right of property, and a mere right of liferent use. To encourage industry, by an interest suited to this extent of view, in order that land may be improved to the utmost stretch of industry, and that capital may accumulate beyond what might merely suffice for a life use in consumption, the command over the property must not be limited to the mere lifetime of the proprietor, but he must be empowered to transmit it to descendants, or other objects of his affection. These views of utility give rise to perpetual and unlimited property, in land and in stock; to the rights of legal succession, and of testamentary destination, and to all the corresponding laws growing out of consuetude, or resulting from foresight. Political advantages here clash; and, unquestionably, the over extension given, in Scotland, to the right of testamentary destination, by the policy of entailing land, has tended very much to damp the spirit of improvement in those who have succeeded to lands held under the fetters of an entail.

The protection of a government, in which the common force of society is concentrated, has ever been found necessary, to defend, equally against internal violence, and external aggression, those rights of the industrious, which a growing sense of common utility ascertains as imperiously demanding such defence. For this purpose, or under this pretext, a common government, under various forms, has been universally adopted by consent, or imposed by violence, with various contrivances of political arrangement, for enforcing submission, or as checks upon tyranny, to avoid the one or the other extreme, of anarchy in the subject, or oppression in the sovereign. And, amidst those imperfections that must necessarily adhere to every human institution, it is extremely probable, that, since the Revolution, there has been obtained, under the British Constitution, a proportion of the true and legitimate ends of government, unequalled in the history of ancient or modern times.

The difference in point of effect between a good and a bad government, on human industry, is incalculable. Under the former, natural disadvantages are overcome; countries, comparatively sterile, are rendered fertile; and inhospitable swamps become hives of thriving industry: whilst under the latter, countries by nature favoured with the richest soil, and the most genial climate, have become seats of famine, poverty, ignorance, and every description of human wretchedness. *

Industry, however, must find for itself its own reward, in its own fruits; and it requires no more to carry it to its full extent of energy. The best government can do no more for it than secure to it these fruits; and bad governments depress it, just in proportion as they diminish this security.

The proper province of good government is, to secure to its subjects equal freedom of action, that every one may be at liberty to apply his time and his talents to whatever employment he finds most to his advantage; to secure the possession of property, and the fulfilment of contracts; to establish freedom of intercourse and interchange; and to defend the persons and properties of the subject from internal violence, or hostile aggression; by providing an impartial administration of justice; clearing the streets and highways of robbers, and the seas of pirates; and by keeping in preparation the means of national defence.

Besides this general protection, there are public works, of infinite advantage to the national industry, which, as standing in need of a more general combination than what could probably be obtained by means of private enterprise or voluntary agreement, do necessarily require the aid or interposition of government.

Indeed, many works of provincial and even parochial utility,

* Great Britain, with Switzerland and Holland, (before their revolutions), might be quoted as instances, on the one hand;—modern Greece, Egypt, &c. on the other.

which are within the reach of private enterprise, and are most properly entrusted to the more minutely attentive and economical management of the district that bears the expense, demand, nevertheless, the delegation of the powers of government, to enforce the concurrence of the refractory, and to compel the surrender (on receiving a fair equivalent) of interfering rights, which might embarrass, or totally obstruct, the execution of useful designs.

The interference of government, also, is often highly expedient, to enact regulations, by which rights (which have grown up through ignorance, or the pressure of imperious circumstances, into a constitution so mutually entangled and interfering, as to prevent the most profitable use of the subject) may be disentangled and disjoined.

When industry is thus protected and encouraged, under a wise, just, and enlightened government, and allowed its free and unobstructed course, its natural tendency is to improve, universally, and to the utmost, the condition of the human race.

An unrestrained indulgence in the powers of procreation, is the only circumstance which, in such a state, could possibly cause industry to fail in producing general happiness and prosperity; for it is evident to demonstration, that, if these powers were universally employed to their full extent, they could at all times very speedily multiply the population beyond all possible means of comfortable subsistence;—an evil which common prudence will in a great measure tend to prevent, under every happy constitution of society, which allows the generality to attain to such comforts in their station, as they would be reluctant to diminish, by too wide a division; and chiefly to be dreaded where the absurd provision of poor's rates holds out a lure to improvidence; or, where the great bulk of the people are placed in circumstances of such hopeless depression, that no prudence on their part can better their situation, nor imprudence make it worse. *

Having premised these general observations, which may supersede separate discussion, when we treat of particulars to which the principles laid down may be applicable, I proceed to the distribution of the subject of this work.

It is indeed extremely difficult to arrange, within the comprehension of a single Number in the Appendix to a General Report, a subject of such extent, as would require many chapters subdivided into many sections. The task, however, shall be attempted. Sect. I. will contain general observations upon Industry, and the classes into which it may be divided. Sect. II. shall be devoted to the consideration of Agricultural Industry, and the means of promoting it, dependent upon political regulation; and although this discussion appears only in form of a Section, (in conformity to the prescribed plan of the Report, which requires such a multiplicity of objects to be embraced under one

* See the luminous *Essay on Population*, by Malthus.

general head), it will constitute the chief part of this discussion; both because Agriculture is in itself the art of primary importance, and because it ought to hold the chief place in a work so materially connected with agricultural inquiries. Sect. III. will more slightly treat of the Industry employed in Mines and Fisheries. Sect. IV. will take the same slight notice of Manufacturing and Commercial Industry. Sect. V. will treat of the Poor, or those who are incapable of exercising Industry—the only legitimate poor entitled to be supported by charity. Sect. VI. will treat of the Population of Scotland in general.

SECT. I.

OF INDUSTRY IN GENERAL, AND THE CLASSES INTO WHICH IT MAY BE DIVIDED.

THE materials of all human industry are drawn from the soil, the waters, or the bowels of the earth; by *Agriculture*, by *Fishing*, or by *Mining*.*

As those engaged in these professions furnish all the materials upon which every other species of industry is employed, and also the substance of every thing that is consumed, they may, therefore, in this sense, be considered as the only *producers*. In strictness of speech, the power of man cannot produce a blade of grass, an ear of corn, nor a single animal; extending no farther than to the direction of the earth's fertility to the production and nourishment of such plants and animals as best suit his uses. As little can he cause a fish to exist in the waters, or a mineral to be formed within the earth's bowels; he can only extract them from the regions where they have been generated, and place them under the command of human power, to be used at pleasure. As the manufacturer, however, only effects a modification upon the form of those subjects which are brought within the power of man by agriculture, fishing, and mining, there seems ground for the distinction, of *producing* and *manufacturing* industry. It is, nevertheless, by no means to be understood, that manufacturing industry ought to be held as *unproductive*, in the sense, at least, of its producing nothing of value in exchange; in which case, according to the proverbial mode of speech, the manufacturer could have nothing but his labour for his pains. For the adaptation of the subject, through his labour, for more pleasurable or convenient human use, communicates to it such additional value, that he can exchange it against a greater quantity of the same subject in its rude state, or against other kinds of manufacture for which he may find occasion.

* Were a division of industry, and of its subjects, to be affected, so pedantically exact as to comprehend every thing, the air might also be taken in, as yielding materials of industry; and hunting and fowling might be enumerated along with fishing.

As the miner must employ various manufacturing processes to transmute his mineral into a purer metal, or other marketable shape, he may, without much violence, be classed with the manufacturer; and, as fishing seldom adds materially to the general means of subsistence procured by agriculture in a nation any way populous, and enjoying any considerable extent of territory fit for culture, the fisher may, in a general classification, be assorted with the agriculturist. The two great prominent divisions, then, into which the industrious population of an extensive political community fall generally to be arranged, are the *Agricultural* and the *Manufacturing*.

These two great classes, it is evident, are the mutual consumers of each other's productions. The manufacturer must depend on the cultivator of the soil for his food, as well as for most of the materials of his manufacture; and, as he cannot expect to be subsisted gratuitously upon the bounty of the cultivator, he can only propose to receive food, as an equivalent, or in exchange for, manufactured produce. The cultivator, on the other hand, could have no inducement to raise more food than he could consume himself, unless he had the prospect of exchanging it for something which he values as an equivalent; and we cannot suppose, that the mere pleasure of feeding idle people should be considered as constituting such an equivalent. The cultivator, therefore, after supplying himself with the means of subsistence, disposes of his surplus produce to the manufacturer, in exchange for the conveniencies of life; and the manufacturer, after supplying himself with conveniencies, must still farther produce a surplus, to be exchanged against food. These conveniencies and necessaries seldom meet, in the simple exchange of barter: the surplus of both may be immediately exchanged against money; but money itself is of no value, but in as far as it can command, in exchange, these necessaries or conveniencies: so that though money may be the universal medium of exchange, yet every transaction of exchange must, ultimately, resolve itself into the simple barter of necessaries against conveniencies.

As capital increases, and exchanges are enlarged, a third class arises, whose industry and capital are employed (to the great advantage of the other two primary classes), in negotiating their exchanges for them, leaving each to pursue, with undivided attention, their respective occupations, and to accumulate a still greater quantity of exchangeable surplus, the produce of their respective employments. This class comprehends the *mercantile* or trading interest, whose business it is, as wholesale or retail merchants, to collect the surplus produce of the two classes of agriculturists and manufacturers; replacing to each that capital which they had laid out in obtaining that surplus, and to be in readiness to furnish to each, that portion of the other's surplus which he requires, in the precise quantity required, and at the precise time when it is wanted.

The three great classes, then, of the industrious population of a nation, (stating them in the natural order in which their labours come to be of general utility), are, the *Agricultural*, the *Manufacturing*, and the *Commercial:* For a surplus of food must be prepared, before there is room for applying attention to the means of convenient accommodation; and there must exist a great surplus produce, both of necessaries and conveniencies, before their exchange can give occupation to a distinct profession, and employment to a capital perfectly separate. *

The cultivation of the soil raises, in general, a great surplus produce, above what is necessary for the subsistence of those employed in its cultivation: And, when we consider the great numbers, beyond the mere cultivators, who, in Great Britain, derive their food from the produce of her soil, aided by, comparatively speaking, a small proportion of importation—the army, the navy, the towns crowded with manufacturers and merchants, the number of persons engaged in the liberal professions, and the multitudes who live on land rents, or other sources of revenue without any particular employment,—we are led to form a very high estimate of the produce of her agricultural industry, and of the skill and ability of those who cultivate her soil. †

Supposing a nation to have been expelled from its territory, by barbaric invasion, or religious persecution, and to have carried along with them a considerable portion of their commercial and manufacturing wealth, and to have betaken themselves for refuge to a station, where (from scantiness or sterility of territory) agriculture could afford no subsistence to the new inhabitants; it might still be possible for the people to derive a plentiful subsistence entirely from manufactures, by exchanging their surplus manufactured produce against the surplus produce of the agriculture of other nations. Or, a nation might even be supposed to subsist in plenty, without exercising the least degree either of manufacturing or agricultural industry, if only possessed of capital to enable them to undertake the business of common merchants, or even merely of common carriers to other nations; in negotiating the exchange of the surplus produce of one nation against that of another, or in merely transporting it for the merchants who had negotiated the exchange. ‡

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* Smith's Wealth of Nations, Book iii. Chap. 1.

† Malthus *conjectures*, from the returns under the population bills, which, though far from accurate, yet furnish data for calculation, that the proportion of the immediate cultivators to the rest of the population is less than one-fifth of the whole.

‡ The Dutch provinces, filled with refugees from the persecution of the Duke of Alva, in modern times, and, more antiently, the republics that

sprang

Were peace to prevail over the whole world, and were it never to be interrupted by the ambition of conquest, the iniquitous spirit of monopoly, or the absurd jealousies of trade, &c. it is possible that nations of mere manufacturers or traders might subsist in security and abundance, precisely as the inhabitants of our towns enjoy security of subsistence from the surplus produce of the agriculture of the surrounding country, though they possess no more territory than what is covered by their houses, and the causeways of their streets. But, considering the numberless causes of hostility that may arise betwixt independent nations, a nation of mere manufacturers and traders, depending upon the will of other nations for food, must stand upon a very precarious footing. Were other nations to enact navigation laws for encouragement of their own carrying trade; were they to attempt, however prematurely or unprofitably, to force on manufactures at home, by absolute prohibitions, or duties amounting to the prohibition of importation of foreign manufactures;—were even the mere caprice of fashion to annihilate the demand for such manufactures as were in use to be prepared for their market; or were any cause of irritation to induce them suddenly to shut their ports;—it must, then, inevitably follow, that the dependent nation (however rich in commercial wealth,—in fixed capital, vested in manufacturing machinery and in shipping,—or in warehouses, replenished with all manner of manufactured goods), must, at once, find all such wealth to have become absolutely of no value, and that the inhabitants must inevitably perish for want of food. The more there is in any nation of a population, dependent upon commerce and manufactures, above what its own agriculture can feed, the nearer it approaches to this perilous and precarious state. †

When the commerce and manufactures of a nation have grown upon the surplus produce of its agricultural industry (as affording a vent for that surplus produce, and as exciting to the production of a still increasing surplus), which is the natural order in which these subjects would proceed, if left to their own spontaneous arrangement; under such circumstances, the commercial and manufacturing population, though it will invariably overtake, yet it will never outrun the national means of subsistence, so much as to expose the people to those dreadful calamities to which a dependent nation of merchants and manufacturers may, without great stretch of probability, be supposed to lie open.

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sprang up on the coast of the Mediterranean, composed of those who fled from the fury of those barbarians who overturned the Roman Empire, are instances of nations reduced by violent causes to depend almost entirely for subsistence upon manufactures and commerce.

† See, upon this subject, Malthus, Book iii. Chap. 9. His views deserve most serious consideration.

Agriculture is the only secure foundation of independent greatness; and nations, whose greatness has depended upon mere commercial wealth, have accordingly ever had a mere ephemeral existence. †

The great effort of the policy of modern Europe, through the greater part of the last century, has been to encourage, by every means, manufacturing and commercial industry, and to entice it, by various advantages of artificial institution, to start before, instead of keeping pace with, the industry of agriculture. Great Britain has not been behind her neighbours in this species of policy; and her navigation-acts, together with the monopoly of the great market of her American colonies, secured to her native merchants and manufacturers, (not to mention the domestic monopoly privileges established in *their* favour against their own fellow-citizens, by bounties on exportation of home manufactures, and prohibitions, or discouragement by high duties upon importation of foreign ones), gave to those of that class such pre-eminent encouragement, that it ought not to be matter of surprise, if her mercantile and manufacturing population has increased beyond that amount which her agriculture can feed; if she should have become dependent, to a certain extent, on the agriculture of other nations for subsistence, and an importer, from having been an exporter of grain.

Great Britain has lately had impressive warning of the insecurity of prosperity founded upon commercial and manufacturing wealth, which so much depends on the will of surrounding nations. It is to be hoped she will be less sanguine than formerly in her expectations from her commercial system of policy, and that she will be more attentive to that more solid greatness,

† Malthus, Book iii. *passim*. The opinion of Malthus seems perfectly well founded, that the dependence of states upon foreign agriculture, for food, is the more secure and least liable to be frustrated: 1. In proportion to their weakness; because, as holding their independent existence merely from the forbearance and toleration of their more potent neighbours, they excite no national jealousy; and there is the less danger of the ports whence they derive their supplies being shut against them, out of national irritation. 2. In proportion to the absoluteness of their dependence; because their demand being constant and regular, the agriculture upon which they depend suits itself to that demand. 3. In proportion to the smallness of the space of territory occupied by the population; because this renders the equal distribution of the supply more easy and unexpensive. What a difference, in this respect, betwixt the state of Hamburgh (when it was a state) and Great Britain? Her greatness does excite jealousy. She depends, chiefly, on her own agriculture, and has no regular demand to which foreign agriculture might be suited. Upon occasion of any great deficiency, like that of the late calamitous scarcities, her demand is sudden, unprepared for, and great in proportion to the extent of her territory, and of her population. In the last scarcity, the demand from Britain not only greatly affected the prices through Europe, but also in America; and Malthus says he was credibly informed, that the price of bread was nearly as high at New York as at London. What must have been our situation had other nations shut their ports!

which rests upon the foundation of agricultural industry, lest a population, fostered above the level of her internal means of subsistence, should be forced down to that level in a manner that cannot be contemplated without alarm.

We shall proceed, therefore, to consider what may be of use to promote that preferable industry, which affords a sure foundation of independent greatness, and which the following observations are intended to discuss and explain.

Sect. II.

Of Agricultural Industry, and the Means of promoting it.

The means of promoting agricultural industry are to be deduced partly from consideration of regulations affecting the holding of land, the appropriate subject of this species of industry—and partly from consideration of regulations of a more general nature, which relate equally to industry of every kind. In regard to the former, or regulations affecting the holding of lands, either in perpetual property or temporary tenure, or in common or several possession, it has been judged proper to discuss this subject in a separate dissertation, which is subjoined as Appendix 5. Under this section, therefore, our observations shall be confined to those general political arrangements, that affect other classes of industry equally as agriculture. And these we attempt to classify under the following subdivisions; 1. Regulations relating to the internal and external commerce, and to the manufacture of agricultural produce. 2. Facilities given, or attempted to be given, to interchange, by fairs, markets, regulation of weights and measures, &c. 3. Facilities to intercourse, by roads, railways, canals, &c.

I.

Regulations relating to the Commerce and Manufacture of Agricultural Produce.

Of the Internal Commerce of Agricultural Productions.

Freedom of internal commerce, (though seldom perfectly enjoyed), is essentially necessary to the prosperity of agriculture. It is evident, that merchants, whether wholesale or retail, are as advantageous and necessary to the raiser and consumer of agricultural produce, as to the producer and consumer of manufactures. So obvious a truth surely requires no illustration. The wholesale merchant takes from off the hands of the farmer, or manufacturer, whatever produce they have respectively prepared for market, replacing, by his capital, the capital advanced by either of them in such preparation, and thus enabling each, with uninterrupted attention, and undivided capital, to continue his respective employment; whilst the retail merchant furnishes himself from the wholesale dealer, thus replacing the capital of the latter, he himself being in readiness to supply the immediate consumer, in the manner most convenient for him; that is, at the precise time when he wants the article, and in the precise quantity that he requires. And where perfect freedom of competition is maintained, the whole of this business must, necessarily, as capital becomes more and more abundant, be transacted, in all its branches, in a manner the most advantageous to all concerned, in consonance to that most indubitable of political axioms,—that, *in proportion to the subdivision of labour and employment, more work is done, and in a better manner, and at a cheaper rate.*

But the laws of every nation, enacted during the periods of their respective ignorance and barbarism, have betrayed equal absurdity, in attempting to deprive agriculture of the encouragement of the free commerce of its products, (to the equally great inconvenience and disadvantage also of the consumer, though no doubt intended for his benefit), in attempting to debar the transport of corn from province to province, by absolute prohibition, or by the imposition of heavy fines to be paid for that liberty; in discouraging the separate profession of the corn-merchant, by construing his employment into a crime, and branding him with infamy; attempting to force the cultivator of the soil thus to become, if possible, the retailer of his own produce. Our statute-book continues to be disgraced with absurd enactments against the imaginary crimes of forestalling and regrating. The only legal relief (excepting that implied in the corn-laws) which has been given by the Legislature against these enactments, is the act 15th Charles II., which only extends to the granting of permission to the engrossing or buying of grain, in order to sell it again, as long as the price of wheat does not exceed 48s. a quarter, and that of other grain in proportion; and even from this liberty are excluded forestallers; that is, those who buy and sell over again in the same market within three months. *

Happily, in Scotland, laws become obsolete through disuse; and it was beginning to be thought that our Scots acts of Parliament upon this subject had died this their natural death, in consequence of the more general prevalence of common sense in that respect; yet in the late scarcities, popular ferment, *justifying itself, no doubt, in the belief of the possible existence of the crime, upon the credit given to legislative wisdom in these* † *enact-*

* Smith's Wealth of Nations.

† Smith, in his *Wealth of Nations*, justly assimilates the statutory crime of forestalling to the imaginary crime of witchcraft, which, also, in its day, was a crime by statute; and, with equal justice, alleges, that if the *nolo prosequi* adopted in regard to the latter, had been extended also to the former, both would equally have ceased to haunt the imaginations of the people.

nts, arose to such an alarming height, that it was danger-
s to refuse, altogether, to give way to it. The decisions of
ır Scots Judges seemed, however, to be marked, in general,
vith a fully greater spirit of liberality than some English deci-
ions upon the same subject. For, though the Magistrates of
Edinburgh, during the scarcity of 1795, prevented wheat, which
had been purchased for Hull in England, from being shipped at
their port of Leith, upon a complaint from their procurator-fis-
cal, (*criminal accuser*); yet, in 1801, the Supreme Court of Ses-
sion reversed a sentence of the Sheriff of Ayr, prohibiting meal,
bought in that county for Glasgow, to be carried out of the
county; in so far defending the freedom of the internal com-
merce of corn; and probably (had it come before them by ap-
peal) they might also have reversed the above-mentioned sen-
tence of the Edinburgh Magistrates.

From the decisions of our Supreme Court, it would appear, that the crime of forestalling is, by interpretation, restricted to the intercepting of grain from the market, by purchasing it when on the road to market.*

It were much better that all such acts were totally repealed. The *Nolumus leges Angliæ mutari*, is a maxim that cannot be admitted, without many grains of allowance: For, though precedent is a good rule to establish certainty of procedure, in cases where reason stands neuter, the mere antiquity of precedent yields rather an unfavourable presumption: To follow it, in all cases, indiscriminately, were to place an enlightened age under the tuition of an age of barbarism; or to make those that see, adopt the blind for their guides.

Of Corn Laws, for the regulation of the Commerce of Grain with Foreign Nations.

When every kind of industry is equally left to shift for itself, capital will naturally be attracted to that employment where it can obtain the highest profit, till such time as the profit of that employment shall be beat down, by competition, to the level of the profits of other employments. The natural demand would be the natural market, and the natural price would be that which yielded the general level profit to the employment of capital.

This general level hath been disturbed, and a disproportionate part of capital has been attracted from agriculture, in the opini-

* Hutcheson's *Office of a Justice of the Peace*. The words of this autho in regard to the Scots acts against forestalling, are, 'Which acts, during t 'late calamitous circumstances of the country, were, for the moment, dra 'from *the happy obscurity in which they had long remained*, in consequenc 'the improved state of agriculture and manufactures, as well as of the p 'liberal and enlightened policy of the present age.'

on of our best political writers, by the encouragements given to manufactures and commerce. In consonance with the principles of the commercial system, an artificial market, and an artificial price, extending beyond the natural extent of demand, and above the natural level of price, have been instituted for these latter, by bounties on exportation; and the restriction of importation, by means of high duties, or of absolute prohibition; that is to say, a general tax, is laid upon other industry, to pay to our merchants and manufacturers such a part of price as shall enable them to sell their commodities to foreign nations as cheap as, or cheaper than, these nations themselves could obtain them by their own domestic industry; and they are also enabled to raise another tax upon their fellow-citizens, by exacting from them a price for their commodities consumed at home, exceeding the level to which it would be beat down by the competition of the manufacturers of other nations, were these freely admitted to our markets; the industry of agricultural production being still further depressed, in favour of our manufacturers, by giving them the exclusive privilege of buying some of these productions in the home market, and totally prohibiting their exportation to foreign nations, whilst the same commodities of foreign production are admitted, duty free, to compete with them in the home market*.

In this manner, it would seem, that capital has been enticed from agriculture to commerce and manufactures, and an excess of population has been raised up, above what our agriculture can feed, and dependent for the means of their subsistence upon the agriculture of other nations. A sense of public safety seems imperiously to demand, that such undue proportion should be rectified; that capital should be restored to agriculture, that the

* This is the case in regard to wool, by the laws of England, to which Scotland became subject at the Union; in consequence of which, the price of wool, in the latter country, sunk one-half after that event. Foreign wool was allowed to be imported duty free; Irish wool was forced into the English market; and the exportation of wool from England prohibited, under penalties which make humanity shudder, and make us deprecate the idea of being ever subjected to that worst of tyrannies, that of monopolizing merchants and manufacturers. 'The severity of many of the laws which have been enacted for the 'security of the revenue,' (says Dr Adam Smith), 'is very justly complained 'of, as imposing heavy penalties upon actions which, antecedent to these statutes that declared them to be crimes, had always been understood to be innocent. But the cruellest of our revenue laws, I will venture to affirm, are 'mild and gentle, in comparison of some of those which the clamour of our 'merchants and manufacturers has extorted from the Legislature, for the support of their own absurd and oppressive monopolies. Like the laws of Draco, 'these laws may be said to be all written in blood.' These laws have been modified in regard to the penalties; which, however, still infer the total ruin of the circumstances of the exporter of wool, though they do not affect his life. 'But as the morals of the great body of the people' (continues the same author) 'are not yet so corrupt as those of the contrivers of this statute, I have 'not heard that any advantage has ever been taken of this clause.' See Smith's Wealth of Nations, Book iv. Chap. 8.

population may not outrun internal means of subsistence; or, in other words, that internal agriculture may rise to the level of the population; and that it may no longer be in the power of other nations, merely by shutting their ports, to cause perhaps two millions of our population to perish for want of food, after the most tremendous struggles about the limited supply which our own agriculture could afford.

The natural equilibrium of our commerce and our agriculture would seem incapable of being restored, but in two ways; either, *first*, By removing the causes which have disturbed it, in breaking down all the hedges and fences of monopoly privilege, by which manufactures and commerce have hitherto been secured in an artificial market, and an artificial enhancement of price; or, *secondly*, By securing the same artificial market and price to agriculture, and keeping it up to their level in point of instituted advantage.

It is the effect of the *corn laws* (commonly so called) to secure these similar advantages to agriculture, by bounties upon exportation, and restricting duties upon importation. And the infinitely superior importance of the subject, will certainly much more justify the interference of regulation in disturbing the natural level in this instance, than in the other.

The paradoxical opinion of Dr Smith, as to the impossibility of such measures giving any encouragement to agriculture, seems to be abundantly refuted by Malthus, (Book iii. Chap. 10.) And surely, if it is at all in the power of artificial regulation to encourage agriculture, one great means must be, by thus keeping the price artificially somewhat above the natural level price.

The tendency of the present corn laws (according to Malthus) is rather to secure an independent supply than an annual excess. A cultivation, however, so extended as to prepare an annual excess for a foreign vent, is the best provision against those recurring years of deficiency of crop, which may ever be expected, at no very long intervals; because, by suspending exportation, and confining to domestic supply the product of that cultivation which the foreign vent had excited, this greater breadth of cultivation will tend to compensate, in great measure, the general deficiency of return over all.

Public granaries have been suggested, as a *still more independent* security against years of scarcity; but the various weighty objections against these, seem to have caused the idea to be abandoned. And, from the very perishable nature of grain, owing to vermin, and other causes, and the great uncertainty of speculations in grain, depending so much for their success on the turning out of the season, a thing which cannot be foreseen, it is not to be expected that much provision against scarcity can be made by storing grain, as a matter of private enterprise: the most that can be thus expected, is, the buying in and storing up of a little of the remainder of the crop of the preceding season, by the time that the greater scarcity of the succeeding crop becomes absolutely certain, or at least highly probable.

Distilleries may be well considered in the same light, as constituting, in effect, an excellent species of granary, inasmuch as they afford a domestic vent to the produce of a cultivation extended beyond that breadth which is necessary, in ordinary years, to supply the annual subsistence of the people, and consequently an encouragement to cultivate to that extent. When these are stopped in a season of scarcity, they open up, for subsistence, the extra supply of that cultivation which had been enlarged in making preparation for their consumption. In this light, horses and dogs kept for pleasure, if not carried to excess, will not appear objectionable; for though, no doubt, the grain consumed by them in ordinary years, would have supported an additional number of human beings, yet, when a deficiency arrives, you cannot shut up existing human mouths, or suspend their operation, as you can shut up the distillery, or suspend corn laws; and there is much more danger to be apprehended, from the pinching of short allowance, from men, than from dogs and horses.

The *Brewery* may, in this respect, be considered in the same light as the *Distillery*, however unusual it may be to consider them as of the same class—*ales* being no more necessaries of life than *ardent spirits*. Equally as the Distillery it affords a vent, in years of ordinary plenty for a superabundance, which, upon shutting it up, would produce even a much superior regurgitation of supply on the recurrence of scarcity. And the same observations are applicable to the manufacture of grain into starch or hair powder.

The intention and effect of the above-mentioned encouragements to agriculture, is to procure a vent, foreign or domestic, (the domestic being preferable, as not dependent on the will of other nations), for the produce of a cultivation extended beyond what is necessary to supply subsistence to the population, in years of ordinary plenty; or, what is the same thing, keeping the population below the level of their means of subsistence, in such years, that the produce of this surplus cultivation, when applied to the purposes of subsistence, may, in cases of deficiency, prevent famine.

Another great resource is in the hands of the people at large, which, however obvious, there seems to be a reluctance to perceive, because it proceeds upon that steady contemplation of the naked realities of human life, which is entirely destructive of those poetic conceptions, pastoral or romantic, on which the imagination delights to dwell. † It is to abstain from that too speedy

† Of Malthus's views it may be said, *Durum, sed levius fit patientia quicquid corrigere est nefas*—They are hard sayings; but we must bear them.

multiplication of the population, (by too early, rash, and imprudent marriages), whence ensues that over abundance of labourers, and consequent competition for employment, which beats down the real recompense of labour to that very straitened and wretched subsistence, even in ordinary seasons of plenty, from which no abatement can possibly be made, without absolute want, and from which no descent remains to any inferior substitute, upon the occurrence of the least deficiency. It is superfluous to quote Malthus upon a subject which he has been the first to place in a clear light. A population, thus restrained, might be numerically fewer, but it would be of more worth; the average duration of life would be higher: and as the population would be supported by the permanence of individuals, more than by their rapid succession,—by diminution of deaths, rather than by augmentation of births,—at any given time there would be a much greater proportion of the population in a state of full maturity and vigour. The advantages of such a state of things, in point of individual happiness, and of national strength,—in the absence of crimes arising from desperate circumsances, and of the dangerous revolutionary spirit, founded in the hope of bettering those circumstances which could not be rendered worse by any change,—in the prevalence of knowledge, and of an enlightened spirit of liberty; these advantages are fully illustrated by this enlightened author, in the Fourth Book of his *Essay on the Principles of Population.*

It may be worth observing, that these measures, intended to procure for agricultural produce the encouragement of an artificially extended market, and enhanced price, could in no shape affect the interest of farmers, excepting merely such whose leases were current at the time of their first institution. For it is perfectly obvious, that rent is given for land, upon consideration of prices; but that prices can in no shape be regulated according to rent. The profit would, therefore, like that of every improvement in agriculture, rest ultimately with the landed proprietor.

The obstructions to the free manufacture of corn from thirlage or adstriction to mills, is considered in Appendix 5.

II.

OF FACILITIES TO INTERCHANGE, BY FAIRS, MARKETS, REGULATION OF WEIGHTS AND MEASURES, &c.

Public Fairs and Markets would not seem entitled to a separate discussion, after what has been already observed in regard to wholesale and retail merchants, were it not that a very undue importance has been sometimes ascribed to their institution and regulation. Misled, seemingly, by the mere similarity of names, some would seem to conceive, that to proclaim a *market* or *fair*, to be held anywhere, is equivalent to the procuring of a *real market* or *effectual demand* for produce.

The difference betwixt a *fair* and a *market*, seems not to be accurately defined; and the terms are, indeed, frequently used as synonymous. If a definition were attempted, perhaps a *fair* might be considered as an instituted meeting, for the purchase and sale, in large quantities, of those commodities, for which the stated demand, though regular, only occurs at considerable intervals of time;—such as, a fair for buying sheep as holding stock; or ewes with lamb to be fattened, lamb and dam, upon grass, or to be fattened upon turnip; or, a fair for purchasing cattle to be wintered in straw-yards; or, for the disposal of these, in spring, to the occupiers of grazing farms, &c. &c. And a *market* might be considered as instituted for those commodities, for which there is a regular and a rapid demand, such as those in great towns, for the weekly disposal of fat cattle to the butchers, and of butcher-meat to the inhabitants, and for meal and oats, to furnish the small retailers, or immediate consumers, who are deficient in stock, or in want of stowage, to purchase more at a time than what serves for weekly demand.

The name of *Fair* is derived evidently from the Latin *Feriæ*; and no doubt originally bore the same import, being originally *feriæ*, in the literal sense; that is, religious festivals, instituted in honour of the saints: And accordingly, the greater part of them still retain the names of those saints in whose honour they had been instituted,—as St Lawrence's fair, St James's, &c. &c. Advantage seems to have been taken of these concourses of people, for the purposes of commerce, (as is the case with the Mahometan pilgrimages to Mecca); and those who had any thing prepared to give in exchange, resorted to them, in hopes of finding others ready to receive what they had prepared, in exchange for what they wanted.

The multiplicity of fairs is an indubitable mark of the barbarism of any country, invariably denoting a deficiency of capital to admit of the proper subdivision of employment, and of the separate professions of wholesale and retail merchants. Accordingly, we have never had fairs for disposal of the large produce of our larger manufactories. And those fairs, for disposal of country produce, which might have been of use to our barbarous ancestors, for want of merchants to take their produce off their hands, are now hardly at all attended: the greater part of them exist only in name, affording, in recalling the recollection of ancient barbarism, a pleasingly contrasted view of the superior civilization of modern times. A few great cattle and horse fairs are frequented. Some of them continue merely as resorts for the half-yearly hiring of country servants; and, of the rest that are attended, many are resorted to for mere purposes of dissipation.

discretion of farmers, as they may find it best suits their conveniency, whether to dispose of their cattle and grain to extensive dealers who come to seek them at their own doors, or to attend with them personally at fairs and markets. The dread of monopoly, by combination of dealers, where there are no exclusive privileges, but the utmost freedom given to competition, is surely now, by all who pretend to the least knowledge of the principles of political economy, considered as suited only to the weakness of childhood, or the imbecility of dotage.

Little or no interest seems to be taken, by the people at large, in the regulation of the cattle markets. In regard to the market of grain, however,—the subject of direful apprehension—much virtue seems to be attributed to regulation; and the object of all regulations is the absurd idea of forcing the farmer to become re-

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'of general principles or of former enactments. Hence, where the offence is 'the same, sometimes one Justice, sometimes two Justices have the jurisdiction; 'sometimes the punishment is one thing, sometimes another, while it is not easy 'to say why it was not *mutatis mutandis*, or rather, why the statutes were not, 'in these particulars, precisely the same. And as these enactments have been 'repeatedly explained, altered and amended, there is scarcely one trade or ma'nufacture that is not the subject of as many statutes as would form a bulky code 'for the whole.' He goes on to observe, that 'whipping is another punishment 'appointed by these statutes to be inflicted summarily on offenders: sometimes, 'too, by one Justice; on the oath, and sometimes (in the case of Quakers) on the 'solemn affirmation, of one single witness. This has been regretted by Judge 'Blackstone, and other writers, as equally inexpedient and unconstitutional.' He further observes, in regard to enactments obtained to prevent embezzlement, that most unconstitutional stretches have been made in favour of the owner. That by 14th Geo. III. cap. 44, 'any *one* Justice may convict a person of false 'reeling, by the oath of any *one* witness, even that of *the owner of the yarn*, who *is 'entitled to the penalty*;' which, says Dr Burn, 'is a singular instance of a con'viction on the oath of a person doubly interested; namely, both as the owner 'of the goods, and as entitled to the whole forfeiture.'

There is surely here a loud call for consolidation, revision, and for annulling, in many particulars. According to information, which seems to be correct, the inconveniency from legislative regulation, in regard to the woollen trade, made parliamentary relief be applied for in 1803, by the manufacturers of Wilts, Somerset, and Gloucester, which was obtained. The statutes complained of were, that of Elizabeth, enacted seemingly in the view of securing perfection of work, and requiring seven years apprenticeships for this purpose, as also imposing a penalty of 40s. a month on those that employed workmen who had not so served. (Prat, in his Gleanings, observes, that this same statute had to be broke through by Birmingham manufacturers.) The others were, those of Edward VI. and of Philip and Mary; the first enacted against machinery, from the popular, but mistaken notion of its depriving labourers of bread; the other restricting the number of looms to be kept by one person,—probably from a dread in the manufacturers lest one or two of the trade might monopolize the whole.

These statutes had not been complied with for sixty or seventy years before; and relief was applied for to Parliament, in consequence of threats of prosecution upon these statutes, from those who thought they had an interest in their observance.

It is not very obvious why the repeal, granted in these instances, might not be made universal.

tailer, to the neglect of his own proper business as a producer. All attempts to force farmers to carry their own grain to market, (whence, indeed, it might frequently have to be idly carried that whole distance back again, to arrive at its destination of consumption), and to sell in bulk instead of by sample, originate in the most contemptible mobbish conceptions.

It is probable that a few cattle fairs may continue to be frequented as convenient. It seems nearly certain, that weekly, or more frequent markets, will ever continue in towns, for provisions; because fresh butcher-meat cannot be stored up; and though flour, meal, or grain can be longer preserved, yet the extent of the retail trade, and its quick return, makes so small a capital sufficient to set up in it, that many are tempted to engage in it, whose capital can command so little at a time, that their small stores need to be frequently replenished from the farmer, or more extensive dealers.*

Weekly markets of grain are necessary for setting the *assize* of bread, wherever it is reckoned worth while to set an assize. Indeed, an assize cannot be set where there are not frequently recurring grain markets, though it would be the most foolish of attempts, to think of forcibly creating a weekly market, merely for the purpose of furnishing data for the regulation of an assize.

The *assize of bread* regulates its price, according to the price of grain. By the two general statutes of 31st Geo. II. and 13th Geo. III, the power of fixing the assize is given, in towns, to Magistrates, and, in the country, to any two Justices of the Peace. Any two Justices of the county, too, may compel the Magistrates of towns within the county to fix an assize, though no such compulsitor is competent to private individuals. Tables also accompany the acts, (probably exact enough), showing, at different prices of wheat and other grain, what ought to be the price of bread of a given weight, and what ought to be the weight of bread sold at a given price.

In towns, where bakers form a corporation, vested with the exclusive privilege of supplying the inhabitants with bread, the fixing of assize may be proper, to prevent the extortions of monopoly. But, if the intention of fixing an assize is, to confine the baker to the natural price, or the price to which bread would be levelled upon a free and full competition, the much more ready way of accomplishing that object, would be, to annul the monopoly privilege, and at once to lay the trade open; and indeed, the annulling this monopoly privilege, would be an alternative of mere indifference to the baker. But the intention of assize seems

* From the smallness of the capital required, as well as congeniality to former habits, farmers, who fail in their circumstances, very generally betake themselves to the retailing of meal and pot-barley, in our great towns. The competition of retailers, is the best security for being cheaply served.

to be, not to prevent entirely the baker from availing himself of his exclusive privilege, but merely to keep his extortions within certain bounds. This, however, is equally guarded against, by a check requiring no trouble nor interference: For the monopoly of bakers does not appear to be so completely hedged about, at least in Scottish towns, but that it still receives considerable check of competition; for, though none may bake, or keep shop within the royalty, but freemen of the corporation, bread may still be baked, and sold in the suburbs; and there is nothing to prevent bakers, without the royalty, from sending bread to those who live within its precincts. And this competition, limited as it is, forms, probably, a protection to the inhabitants, equally as good as that afforded to them by an assize. Hutcheson, in his *Justice of Peace*, observes on this head, that in some parts assize had been discontinued, and that, on comparing the prices with those where assize was fixed, it did not appear but that the public interest might be safely entrusted to this operation of private competition.

Fiars, or the average price of the grain of the crop in correct consumption, have, from time immemorial, been in use to be fixed (technically *struck*) by the Sheriffs of counties, to ascertain the conversion money-price of grain rents, or other annual payments in grain. The Sheriffs' mode of procedure is regulated by an act of sederunt of our Court of Session in 1723. By this act, it is ordered, that they shall be struck in every county, betwixt the 4th and 20th of February each year, for the crop of the preceding season; that, to this effect, the Sheriff shall summon a competent number of persons of skill, out of whom he shall choose a jury of fifteen, of whom eight at least shall be men of landed property; that, before these, in open court, evidence must be produced of the prices of that crop, from the November preceding; any person present being entitled to offer information, as to the evidence that is produced, or that might be produced; and if it appear to the Sheriff or the jury, that the evidence produced is defective, they shall adjourn. Afterwards, the jury is to be sworn, and the evidence to be produced, when the jury are to be enclosed, and to return their verdict; according to which, the Sheriff must determine and record the fiars' prices by the 1st of March, and the clerk be in readiness to furnish extracts.

The fiars may afford a commercial facility to inexperienced farmers, in selling by them, either exactly, or a little higher or lower, according to the quality of the grain.

The Agricultural Reporter of East Lothian very justly remarks, that the period of the year of which the prices are ordained to be taken in proof, cannot afford a just average of the prices of the crop. At the commencement of the season, the worst got grain, which is in most risk of not keeping; and the least valuable, is thrashed out and disposed of. Candlemas being also the usual Scots term of paying rent, the farmers of small capital are rather in haste to convert their grain into cash, that they may be ready for pay-day, thus occasioning some degree of glut of the market, and reducing the price below the average. He proposes Whitsunday as a time for striking fiars; when the prices, from the preceding November, would give a fairer average of the whole price through the year. In this opinion, we concur with him.

He notices also the mode of procedure which has been followed by the Sheriffs of East Lothian, to counteract these causes of error;—a mode which seems peculiar to that county, but which ought, perhaps, in justice to all concerned, to be universally adopted, unless Whitsunday, instead of Candlemas, shall be fixed as the time for striking the fiars. In regard to each particular grain, a general average is taken of the whole prices produced in evidence; and this average is fixed as the medium, or second price of that grain: An average is then taken of all the prices that have exceeded this medium, and this average is fixed as the highest, or first price: An average is then taken of all the prices that have fallen short of the medium, and this average is fixed as the lowest, or third price. This being done, 2½ *per cent.* is added to each, to compensate for the lowness of price, from being taken at a cheap season of the year.

Weights and Measures.

The uniformity of these would prevent much embarrassment and uncertainty in the commerce of corn, and of every other article.

No new act of the Legislature is at all required to produce this desirable end. It is already perfectly provided for by the 17th article of the treaty of Union betwixt the two kingdoms, which ordains that the same weights and measures, which constitute *the legal standard of England*, shall, thenceforward, constitute the legal standard of Scotland, and that standards of weight and measure shall be sent from the standards kept in the Exchequer in Westminster.

That there actually exists a legal standard in England, is ascertained by very recent decisions of the English courts, who have decerned in the legal penalty, for using other than these legal standards.*

The author referred to in the note, takes, indeed, notice of a difficulty that hath occurred, although it seems of a kind which might easily be overcome. He observes, that, in regard to Scotland, both the Legislature, and our Supreme Court, seem equally to have overlooked this 17th article of the treaty of Union;

* Hutcheson's Justice of the Peace.

as, by 24th Geo. II., lint and hemp seeds are ordained to be sold by the *Linlithgow barley measure;* and our Teind Court have uniformly modified victual stipends in the same measure.

It would certainly, however, be matter of no great difficulty to revive this 17th article, by a declaratory act. Nor would it be matter of much difficulty to have the proportions of the existing measures and weights of every county to the standards (declared legal by this article) ascertained by authority of the Sheriff and Justices, acting with proper assistance, and stated payments of existing measure determined in such a given denomination of the legal, as should keep them equal to what they were before. Let the proportions of the legal, to the accustomed standards, be then advertised, in the most public manner: Let provision be made for the inhabitants of the county furnishing themselves with these standards, and let a proper time be allowed for the inhabitants so to furnish themselves; and let it be declared, that, after the lapse of this period, the penalties of the law will be rigorously exacted from every person who shall use any other weight or measure than the legal.

People are apt to disturb themselves by the anticipation of imaginary embarrassment that would occur in the use of new weights and measures, which they conceive themselves not to understand. Custom, which has reconciled us to the use of those with which we are acquainted, would, however, in the same manner, reconcile us equally to any new standard that might be adopted. In fact, all standards must at first have been arbitrarily assumed; and when we say we understand a weight or measure, we can only mean that we know how many times it contains, or is contained, in the standard which we have assumed. As to the standard itself, we can do no more than point to the lump, or to the rod, which we have agreed to name a pound of weight, or a yard of length; and any lump, or any rod, would have served the purpose, just as well as any other. *

That slight of hand may be guarded against in measuring of corn, it were proper that the measuring vessel, made of cooper's

* The parts of the human body seem to have been universally referred to, as original standards of measure; such as the *pes et ulna*, the *foot*, and *uln* or *eln*. It is said, that Henry I. of England caused a rod to be made, of the precise length of his *ulna* or *arm*, (measuring, it is likely, to the breast bone), and that this was fixed as the standard of length, and so continues. In Scotland, we have referred to the breadth of the thumb, at the root of the nail, as an inch; and to the length of barley-corns, as component parts of an inch, &c. The inconvenience of referring to natural objects, where the same denomination is applied to all the variations to be found in individuals, must soon have indicated the necessity of adopting, as a standard of length, something made of unaltering materials, as a rod of iron or copper. After fixing a standard of length, it was easy from this to determine length, breadth and depth, or all measures of dimension. It would then be as easy to determine a standard of weight, by making a piece of gold, for instance, of certain dimensions, the pound.

work, should have the sides rising perpendicular from the bottom, the swell necessary for tighting the hoops being effected by the staves of the side being thicker at bottom than at top. Or if the vessel's sides diverge a little from bottom to top, (which would still better secure the grain filling the angle formed by the bottom and sides, so as to prevent slight in measuring), the staves might be of uniform thickness.

In the opinion of some, selling of grain by weight is approved, as leading to a more precise judgment of its value. Whilst others conceive, that, after ascertaining the weight, about as many circumstances, affecting the intrinsic value, are still left indeterminate, as, in merely ascertaining the measure,—such as the dampness,—the quantity of husk,—and the proportion of saccharine, which is by no means proportionate to specific gravity.

Regulation of Prices of Provisions, and of Labour, &c.

In barbarous times, before the art of government was understood,—before it was ascertained what government could, and could not do,—and what it ought, or ought not to attempt,—the power of regulating these was given, by our antiquated statutes, to the Justices of the Peace.

The regulation of the *price of provisions*, if that power was ever at all exercised, has fallen entirely into disuse; * and, indeed, nothing could be more dangerous than such interference. If it were to be exercised, it is to be presumed that it would never interfere in establishing a *minimum*, in times of extraordinary cheapness: or, if it did, no power of government could make the regulation be observed; the producer, glutted with superabundance of his commodity, would be glad to get it off his hands at any price: And who would complain of being served over cheap?

It would never be used, but in establishing a *maximum*, in time of scarcity and dearth; and nothing could be more dangerous. The power of government cannot possibly create food; and, where there is a deficiency, the only resource against famine is short allowance; and the only possible enforcement of general short allowance, is high price. Price would be regulated, in the very best manner, by the interest of the dealers and competition of purchasers, if matters are left to their natural course; for if the price is kept so high, at one time, as that its too great enforcement of short allowance slackens the demand, so as to make it probable that the existing crop upon hand cannot be got disposed of at that price, but that the price may probably come to be greatly depressed, by a better ensuing crop, the dealers

* The assize of bread is no exception;—for though it seemingly regulates the price of bread, yet that price is regulated by the price of grain, which is not regulated, but left to find its own level in the market.

will then bring more to market, to avoid this risk of loss; or if the demand is so great, at the existing price, that there appears to be a probability of the existing consumption soon rendering the existing stock so very scarce, that a very great augmentation in price may soon be expected, dealers will then diminish the rate of supply of the market, till the probability recurs of the opposite alternative. Nothing can happen more salutary than these operations; and no operation can, with more certainty, be depended upon, than that which ensues, of course, from the self-interest of those concerned. *Such measures,* we say, *execute themselves.*

But, if the powers of government were to be interposed in fixing a *maximum*, lower than what these natural operations of self-interest would establish, the consequence would be, the encouragement of a rate of consumption higher than the existing supplies would allow of; and, if the whole were consumed at that rate, even a single week before the return of another crop, the people must die of famine. And if an interference were made, merely to enforce what would ensue of course, it must be entirely nugatory. The matter is left perfectly safe in the hands of dealers, who alone, indeed, are in the capacity of calculating aright, from their habitual experience in feeling the pulse of the markets. *

Regulation of wages of labour has sometimes been attempted by the Justices of the Peace; but, as Hutcheson observes in his valuable work, 'this very delicate jurisdiction they have hitherto 'exercised with much discretion.' Where labourers are few, in proportion to the extent of capital to employ them, wages must rise, from the competition of capital; and where they are more numerous, in proportion to capital, the competition of labourers for employment, must beat down the rate of wages; any regulations counteracting this natural tendency must themselves be counteracted and evaded. In the first case, high wages encourage the multiplication of the population to the extent of the work; in the latter, low wages are necessary, that each may get his share; for even the omnipotence of an act of Parliament cannot create capital to afford employment to every given number, at high wages.

In great towns, the resort of strangers, ignorant of the state of the country, and where there are frequently recurring occasions for immediate and short services, which cannot wait for examination of market rates, such as those of porters, chairmen, and hackney-coachmen, it seems very proper that the rate of such services should be fixed, at short intervals, *in proportion to the ordinary rate of labour*, and published.

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* See Smith and Malthus. Agricultural Report of Tweeddale, Note H.

Regulations of the hire of capital are fixed by the Legislature. The profits from the actual employment of capital are left to find their own level, except in so far as, by bounties and exclusive monopoly privileges, the industry of towns has been encouraged above that of the country, and capital been enticed, by superior profit, from agriculture to manufactures and commerce. But the profits of those, who, instead of employing their capitals themselves, hire them out to others, who are to employ them, have been regulated; or, in other words, the Legislature has fixed a *maximum* rate of interest of money.

III.

OF THE ESTABLISHMENT OF FACILITIES OF INTERNAL COMMUNICATION,—BY ROADS—CANALS—IRON RAIL-WAYS, FOR THE ADVANCEMENT OF NATIONAL INDUSTRY.

WERE every other encouragement given to agriculture, it would be in vain, if the means of internal communication were impracticable or difficult.

Roads are of indispensable utility, to promote the internal commerce of agriculture and of manufactures; as well as to bring the whole of a state under the equal controul of the government, for the extension of the authority of law, and the general security of justice.

It was the first care of the Romans, to traverse their conquered provinces by roads, for the extension of authority, or partly for the facility of oppression, but, undoubtedly, to the effect of the diffusion of the useful arts, and the general extension of civilization. The military roads, in Scotland, were formed by Government, particularly through the Highlands, for the equal extension of authority, and with the happiest effect, in every point of view.

But, though it certainly best suits the general government to execute works, of such enlarged contemplation, at the public expense, and under its own immediate direction, it seems, nevertheless, generally understood, that, where the object in view is merely that internal communication which is necessary, for facility of that interchange so indispensable to universal industry, the management is best entrusted to local funds and local administrations, from which may be expected more attention to economy of outlay, and to all the *minutiæ* of detail in the execution.

The general administration of the public roads has, in Scotland, by the statutes 1617 and 1660, been entrusted to the Justices of the Peace, in their respective counties: By subsequent acts, which, also, make some other alterations and amendments, (such as acts 1669, 1670, 1686, and acts 5th Geo. I. and 7th

Geo. II.), the Commissioners of supply * are conjoined with them, (probably in the view, that, from enlarging its basis, there would be less danger of combination for purposes of mutual private accommodation). These administrators are enjoined to hold two general yearly meetings; one in spring, 30th of April, (when the Commissioners of Supply lay the county assessment for the land-tax), and the other at Michaelmas. These meetings are empowered to provide, that all highways are of proper breadth, (in early times, by statute, forty feet, subsequently reduced to twenty, clear of the drains on both sides); to prevent injuries to them, to remove hedges where necessary, &c.

The fund provided for making roads, by these enactments, is a certain number of days' labour from the occupiers of the lands, upon those parts of the public roads which run through the parishes where they reside. This is called the *statute labour*, (from being enjoined by statute); and a similar provision, for making roads, seems very generally to have been adopted, and to have been, in many countries, a source of great oppression. † Our enactments have guarded against all arbitrary exactions, having strictly limited the extent of the service, and restricted the time of its exaction to the least inconvenient season. The number of days is limited to six yearly, viz. three before the last day of June, and three after harvest, and to *four days in the year thereafter*,—a clause which seems to imply, that, after any person has once given six days' labour, he is ever after liable only in four yearly. Originally, this obligation extended only to tenants and their cottars, who were to appear with their carts, horses, and implements, but was afterwards extended to all the inhabitants. Heritors are not liable in statute-labour,—an exception for which there seems no good reason; but in case of its deficiency they are empowered (and undoubtedly power delegated ever implies an obligation to use it, for the purpose for which it is given, unless the purpose is such as suits only the views of a barbarous age) to assess the landed interest, at a general meeting of heritors and freeholders, to be held yearly upon the first Tuesday of June, to an extent not exceeding 10s. Scots on every 100*l*. Scots of valued rent,—an assessment which, from the universally experienced deficiency of the statute-labour, it is probable, was soon imposed over Scotland, and continues to be levied, under the name of *road and bridge money*.

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* Landed property of 100*l*. Scots of valuation, is the qualification for being Commissioner of Supply. Justices of the Peace hold their office from the King's commission solely.

† Young, in his travels through France, takes notice of the great oppression of the *corvée*, or statute-labour,—valleys needlessly filled up, at prodigious expense, and prodigality of labour,—and wanton sacrifices of private property,

The Justices and Commissioners are also authorised to divide themselves into district meetings, and to empower whom they please of their number, to call out the statute-labour, and to appoint overseers; and they are empowered to accept of money-commutation, instead of actual labour.

Such are the outlines of *the general statutes*, by which a legislative provision has been made, for securing the internal means of communication, by roads; and these regulations are in force, excepting in so far as they are altered, in the particular county acts of Parliament.

As internal commerce increased, and the augmented produce of agriculture and manufactures required more extensive and more easy and speedy modes of conveyance, it was soon found, that this legal provision of the statute-labour was perfectly inadequate to maintain the necessary communication by roads. And accordingly, from about the middle of the last century, private acts of Parliament came to be applied for by the several counties, to place the roads upon a different footing, and, by the privilege of erecting toll-bars, and exacting toll from passengers, to create a fund for forming and upholding the roads, out of a moderate tax paid for their use.

In such a moderate tax, it seems sufficiently equitable, that the users of the road should pay, at different rates, in proportion to the tear and wear which they respectively occasion; though, were the tax of any considerable amount, it would thus fall heaviest where it can least easily be borne,—the value of commodities, transported by roads, being nearly in the inverse proportion of their bulk and weight. In all the acts, this latter principle seems so far complied with, that the rate of toll is augmented upon the carriages kept for pleasure by the rich.

It might be equitable, that, wherever the use is enjoyed, it should be paid for; but, on roads little frequented, the expense of collection would eat up the tax, and therefore, toll-bars, and collectors of toll are only admissible on the roads of most public resort. These are called, therefore, *toll* or *turnpike roads;* the others are designed *by-roads*; and while the produce of the tolls is appropriated to the making and repair of the toll-roads, the by-roads are made and upheld by the statute-labour; sometimes, the labour being exclusively appropriated to particular roads, that of each parish to the part of the road lying within its bounds, or sometimes made transferable (by consent of the managers in the parish) to other parishes within the county.

The private county acts not only contain, in general, power to collect taxes, or tolls, at toll bars, but comprehend and regulate the statute-labour. It would indeed seem, that while Scotland was but raw and inexperienced in road making, some of the counties, in their first applications to Parliament, only applied for, and obtained a power, to convert the statute-labour into money; to borrow money upon it as a fund, and to assign it in security; and also, the power of increasing the assessment upon landed property, (given by the original statutes to supply the deficiencies of the statute-labour), to an higher rate than the statute rate of 10s. Scots upon every 100*l*. Scots of valuation. It seems, however, that, from the inefficiency of these measures, such counties soon found it necessary to resort to the mode of obtaining a power of taxation, in collecting toll from passengers, finding that the statute-labour had sufficient employment, in making and upholding the by-roads.

The modes of converting the statute-labour into a money-payment, (soon found to be most convenient for all parties), have been various, in various county acts; and the rates of conversion vary under the same mode. It seems pretty common to assess the lands at from 20s. to 30s. Sterling for every 100*l*. Scots of valuation, or at the same rate upon every 100*l*. Sterling of real rent; or, where the farms are all arable, at the rate of from 20s. to 30s. Sterling for every plough, or upon every fifty, sixty, or seventy acres of land, according to its quality. Very commonly, this assessment is paid in by the proprietor to the county collector, along with his cess, he being left to apportion it among his tenantry; and he himself paying, along with them, for the proportion of his lands occupied by himself. And sometimes, (to prevent the commutation of the statute-labour from sinking in value, with the depreciation of money, during the currency of the act of Parliament), the 100*l*. Scots of valuation, or 100*l*. Sterling real rent, or the ploughgate, (that is, from fifty to seventy acres of arable land), instead of being assessed at a fixed price, is assessed at six days' labour of a man with a horse and cart, to be paid, not in kind, but in an equivalent money-conversion at the time.

The mode of converting the statute-labour of the other inhabitants is also various. Sometimes horses kept for pleasure, or by carters and carriers, &c. are made to pay at the rate of six days' labour of a man with a horse and cart; and all other inhabitants of full age, and householders, at the rate of six days or four days' labour of a man; with power to the trustees to make exemptions or abatements, according to circumstances.

As there may be every variety of difference, in regard to the number and expense of by-roads, to be supported in different parishes, the statute-labour, conformed to the general statutes, ought to be declared the *minimum* to be exacted, and power ought to be obtained, to assess for more, if found necessary.

The county acts vary, too, in regard to the qualifications of those entitled to act as trustees. In general, it may be said that the management is vested in the landed interest of the counties, in conformity with the spirit of the general statutes; and it cannot be in better hands, roads being of indispensable importance to agriculture, in which the landed interest is so deeply interested; and, in so far as publicity insures rectitude to measures, nothing being more subjected to the check of public opinion, than the administration of roads. Sometimes, however, we find the basis of administration has been narrowed injudiciously, in confining the trust to those possessed of 400*l*. valuation; more commonly, it is enlarged to comprehend all landed proprietors worth 100*l*. Scots valuation, or 100*l*. Sterling of rent, or, even monied men, having no land, if worth 2000*l*. capital. Chief Magistrates of royal burghs are also always trustees.

If vested, solely, in a few proprietors of overgrown fortunes, there cannot be a doubt, that economy would be less consulted, and that the funds might be diverted from use to ornament; such as, magnificent approaches, bridges contrived for the vista, &c. He would doubtless be held a Goth, who should object to public ornament. If there are not funds for both, however, use ought assuredly to take the lead: it is profitable use, that can pay for itself, and yield a surplus, which can alone supply the means whence ornament can be afforded.

The broader the basis of administration, there is the less danger of combinations for mutual accommodation. Probably, it might also be desirable that the trustees should be accountable to some other judicature than that of their own body, if only a board could be formed to that effect, upon such principles, as not to turn out a mere creation of office, for the purpose of influence. The responsibility of trustees to Judges on the circuit, is fallen into disuse.

Very generally, the trustees on the toll and by-roads are the same persons. In Kincardineshire, we find liferent tenants, or farmers having leases for nineteen years, admitted to the administration of the statute labour, and by-roads,—a constitution deserving of imitation.

The general term of the county acts is for twenty-one years; but there seems no good reason why it should be so limited, and the county subjected to the weighty expense of a fresh application to Parliament. If the officers of the Legislature should feel a diminution of perquisites, from a prolongation of the term, why not proportionally augment their salaries?

The *maximum* of the toll exigible is stated in these county acts, and the *maximum* conversion of statute-labour, with power in the trustees to lower both rates; only they must, in lowering them, have the consent of those who lent money upon them, at a given existing rate.

All the reporters concur, in representing a great waste of expenditure as having taken place, when the counties first set on foot the reformation of their roads, upon the powers of their special acts of Parliament, from an ill judged economy, in attempting to repair the old existing roads, instead of forming them altogether anew,—a measure that oft times, after much idle expense in attempting to reform what was incorrigible, required to be ultimately resorted to. Before wheel-carriages were much in use, levelness was of less moment, the straight line was preferred; and if this led over hills, rather than round their base, this circumstance was rather considered as eligible, in generally affording a harder bottom for the road. Even in the military roads, (in regard to the making of which, the execution was neither hampered by scarcity of funds nor deficiency of discretionary power), the same error has been generally committed, which shows the difficulty of attaining to just theory, till it has been corrected by practice.

Those counties may probably be accounted the most fortunate, who were the latest of starting in the enterprise of road-reformation, as they could profit by the errors of their precursors.

In this respect, the county of Kirkcudbright seems to have been peculiarly fortunate, where nothing of importance seems to have been attempted till 1796, when they obtained a road act, for the first time empowering them to collect toll. Much of the high state of improvement of the roads in that county, is ascribed to the indefatigable perseverance, and superior intelligence, of the late Basil William, Lord Daer, who had particularly turned his attention to that subject, and had improved upon the ideas of the late Sir George Clerk of Pennicuik, as to the mode of conducting level roads through hilly districts. Lord Daer first exemplified his ideas, by planning an entire new set of farm-roads, for his father the Earl of Selkirk's estate, paying no regard to existing roads, nor even to the disarranging of existing enclosures. After much ineffectual representation, and even overcoming some opposition, which arose from paltry self-interested views, at the expense of some pecuniary sacrifices, he prevailed, some time before his death, in having his plan adopted, in some miles of a road undergoing repairs; and the marked contrast betwixt this part and the rest, began to open the eyes of the country. Many of his proposals, it is said, looked upon at the time as chimerical, have at length been adopted, to universal satisfaction.*

One excellent maxim, the reporter observes, is uniformly acted upon in the stewartry of Kirkcudbright, since the time of Lord Daer, 'that no repairs shall be laid out upon any of the old roads, 'exceeding 20*l.* *per* mile, till a surveyor shall have reported that 'the road is in a proper direction; and that every new line of 'road proposed shall first be laid out by an engineer, with pro-'per instruments, inspected by a committee, and approved of by 'a general meeting, before the work can be carried into execu-'tion.'

* See Agricultural Survey of Galloway. He had to be his own engineer, that profession, as to roads, being then unknown in Scotland; and he invented a level, with a piece of mirror attached to it, reflecting, to the eye, the air-bubble of the spirit-tube, at the same time that it is looking at the object through the sights; which renders the instrument extremely handy.

In regard to the parliamentary powers applied for by counties, I shall just farther observe, that they have generally found it necessary (after wielding for a while the powers at first applied for, and obtained as sufficient) to make application for an enlargement of these powers, both as to the raising of funds, and compelling the surrender, on fair equivalent, of private rights of property, standing in the way of improvement, either as to the widening of the roads, giving them a more proper allignment, or procuring materials for their formation.

In regard to the mechanical construction of roads, there is not much specification to be found in the County Reports, (see Appendix 3.)

In the county of Kirkcudbright, the road most commended by the Reporter, is one from Dumfries to Newton-Stewart, a distance of fifty-two miles, planned by an engineer trained by Lord Daer. It is forty feet wide between the hedges, five feet being allowed for a foot-path. * Another, from thence through the county of Wigton to Port-Patrick, is, indeed, only thirty feet wide betwixt the fences; but, in this, level has been so much consulted, that, with very few exceptions, the acclivity does not exceed 1 in 40, the greatest being 1 in 30. In Berwickshire, the stage upon the great English road, from Ayton Bridge to the English border, has very lately been made anew. The greatest acclivity exceeds not 1 in 42, excepting in one place, where it is regretted that it had unavoidably to be 1 in 32. This road is forty feet wide, sixteen feet in the middle metalled, allowing of a summer road on each side, each of which may, in alternate years, be travelled upon in dry weather, or serve as a space in which to deposit the materials of repair. In regard to level, however, there seems to be an opinion, that if it prevails too much, and too invariably, the uniformity of the pulling, fatigues draught-horses more than if it was at intervals relieved by somewhat greater acclivities, although requiring occasionally greater exertion. Upon somewhat similar principles, it may be observed, that, where a very long ascent is unavoidable, it might be proper, at intervals, to form a part so near to level, that horses might rest a little without bearing against the yoke, even although, by so doing, the different stages of ascent must necessarily have a little more rate of acclivity.

In regard to shape, the *convex* seems to be preferred; a segment of a large circle, but not so large as not to afford a decline of at least 1 in 36, from the crown of the road to the side drains; at a less rate of declination, water could not run off the road; if much greater, unless the horse keeps exactly the middle of the road, the weight rests most on the lower wheels, and the

* Madame Rolland was at once struck with an idea of the happiness of the British constitution, upon observing this marked attention to the lower orders, in the English roads.

draught presses most on the corresponding shoulder of the horse, which leads the animal to strive to regain the middle, and necessarily continues the track to this one part of the road. This same inconvenience would result from a *concave* shape, in proportion to the depth of the hollow; at same time, by throwing all the rain-water falling upon the road into the middle of it, the track of the horse's feet would soon become mire. The exact *level* would, in respect of wetness, be preferable to the concave; and as the weight must ever be equal on both wheels, no track would be preferable to another. In an *inclined plane*, no track would be preferable to another; water might get pretty easily off; but the weight would always rest unequally on the wheels, causing unequal wear; and in hard frosts, this shape would be extremely dangerous. It must be stated, however, that the concave figure (which is unknown in Scotland) is said to have been adopted, and to have given satisfaction in some parts of England, where it is also the practice, occasionally, to clean such roads, by the admission of a stream of water.

In the original formation of roads, rolling has been recommended, for consolidation of the materials; as also harrowing, followed by rolling, for filling up ruts, in the course of repair. But as a roller cannot press regularly but upon a rectilinear surface, if rolling is thought requisite, the road should, in its formation, be made of two planes, inclining to the side ditches, and meeting in the centre of the road, at perhaps an angle of 175°.

Though provision is made for receiving and conveying the water running from the crown down the sides of the road, and for keeping off the water coming from contiguous lands, by side ditches and underground conduits, it is yet found, that the rain-water falling upon the road itself, will often run along it, for a long space, in the horse-tracks, or ruts made by wheels. To remedy this, paved surface-gutters, very shallow, have been recommended to be carried, at short distances, across the road.

In all roads, (except those on a dead level, or a single inclined plane), whether they rise or sink in the middle, the draught-horse cannot move at ease, but when walking in the middle of the road; of course the wear of the road is confined to one track. To counteract this inconvenience, various plans have been suggested, either to compel all wheels to be broader in the shoeing, that they may act as rollers, in compressing, instead of cutting the road; or to provide for a varied track, by compelling every person, having more carriages of any sort than one, to have axles of different lengths for the wheels of each carriage. A varied track has been also successfully enforced in the upper ward of Clydesdale, from a peculiar mode adopted in repairing the road, which is to fill up only one of the ruts made by the wheels at one time, which necessarily compels a desertion of the old track, and a more equal distribution of the tear and wear.

Another proposal for obviating this evil, has appeared in the cots Farmer's Magazine, of laying the whole track, where the heels move, with solid blocks of whinstone, supported by ma-inry. In soils of clay, Mr Beatson proposes a road made per-ctly level on the surface, as best adapted for such a situation, nd which would, of course, prevent any tendency to one par-cular track. The enclosures on the road-side must be made ith the ditch towards the field, and the hedge or paling to-ards the road. The road is then formed of two inclined planes, ieeting in the middle of the road, of strong clay, with small onduits at short distances, from the small inner ditches along ie sides of the road, to the outward ditches. The road being ien consolidated by rolling, the whole is covered, and brought a level with sand, rising some inches above the crown of the oad. A stratum of broken stones, of six inches thick, is laid bove the sand. The water, percolating through the upper ma-erials and sand to the clay below, is, by the shape of the clay, hrown into the outward ditches, by the small conduits. Every art of this road being equally travellable, it could admit of be-ng made of less breadth.

Perhaps the only good rule for keeping roads in repair, is to eep up a constant stock of materials and labourers; and, that he expense may be more easily afforded, never to make two oads where one might serve both purposes.

The expense of road-making must vary, to the greatest a-nount, in consideration of the wide differences of local cir-umstances. The road in Berwickshire, already alluded to, ncluding expense of bridges, and of compensations for da-nage done to private property, is stated at 1000*l.* per mile. n the shires of Ross and Cromarty, the statement is 250*l.* per nile, owing, it is said, to the number of bridges requisite, al-hough, from the economy necessary, the roads are made only ifteen feet in width. In Galloway, the expense is stated at 100*l.* er mile for toll, and 50*l.* for by-roads, seemingly without in-luding expense of bridges, one of which, thrown over the Dee t Tongland in 1808, consisting of a centre arch of 110 feet span, nd three Gothic ones on each side, to bring the road to its le-el, cost 7350*l.* This is probably the largest arch in Scotland, xceeding the one over Tweed, at the foot of Leader Water, by ive feet of span.

Dr Adam Smith (Wealth of Nations, Book V. Ch. i. Part 3.) tates, that the revenue from tolls, after upholding the roads, ad been held in contemplation by some ministers of state, as a esource that might, some time or other, be applied to the exi-encies of the state, without burdening the people; particularly, s the repairs might be executed by Government at small ex-ense, by employing the military, upon a small increase to their pay. Against such a system of upholding the internal communication, he no doubt there states insuperable objections. But, in the text, he is led to state, that the clear revenue which it was imagined might be gained from this expedient, would amount to half a million. In the edition published in 1786, he subjoins the following note: 'Since publishing the two first editions of this book, I have got good reasons to believe, that all the turnpike tolls levied in Great Britain, do not produce a neat revenue that amounts to half a million—a sum which, under the management of Government, would not be sufficient to keep in repair five of the principal roads in the kingdom.'

Had the Doctor lived till now, he would probably have been led to state, in regard to Scotland at least, that the turnpike-tolls, so far from yielding a neat revenue, from which a sinking fund might be established, to pay up in time the principal of the money sunk in making them, do not, in general, yield, after expense of repairing, as much as will pay the common rate of interest. It is very supposeable, that Scots trustees, in general, would be extremely well satisfied, were the tolls merely to uphold the roads, and pay common interest, though there should not be one farthing of excess, to constitute a sinking fund for redemption of the principal. But, very generally, the tolls are insufficient to answer even so moderate a demand. Instead of reimbursement, the trustees must lay their account with an immediate loss. Their profit can only, indirectly, though certainly, result from the facilities given to agricultural improvement.

By late decisions of our Supreme Court, the money levied by turnpike tolls, must be preferably applied to the repairing of the roads, to the postponing of the payment of the interest of money borrowed upon the security of the toll.* Though the trustees may hold out the security of their tolls, few monied men may therefore choose to lend money on such security, unless fortified by the additional responsibility of the trustees. The gentlemen of the several counties are, therefore, in fact, or will soon become, the sole creditors upon the tolls; and it is most generally a very losing concern. The Reporter of Clydesdale states, that, in several instances, the tolls yield not above 3 *per cent*. In Aberdeenshire, I have heard the yield of the tolls stated at the same sum.† The Reporter of Roxburghshire states, in exact details, the return from the tolls; whence it appears, that, after upholding, there is only an overplus of 84*l*. yearly, to answer for the interest of about 46,000*l*. sunk in the formation of the roads. I have since been informed, that the gentlemen

* A decision somewhat equivalent to the English public right of *indictment of roads*.

† I have been informed, that, in some parts of that county, owing to distance from materials, some roads have cost, in the mere making, and not including either bridges or compensation for property, 1000*l*. *per* mile.

of that county have paid off the other creditors, dividing the loss among themselves.

Such is become the difficulty of obtaining money to borrow upon the security of tolls, that, in the turnpike act about to be applied for by the county of Perth, (and the same measure will probably obtain legal sanction, in the general enactment as to turnpikes, at present under consideration), recourse is to be had to the mode of *forced loan*, by powers to be vested in trustees, (comprehending every landed proprietor rated at 100*l.* Scots valuation), of assessing all lands connected with the road, in proportion to the benefit they shall be adjudged, by arbiters, to receive from it; for the amount of which assessment, they shall be obliged to accept, as their security, of the toll-duties, assigned to them as preferable creditors.

Under such circumstances, the exemption of mail coaches from payment of toll, seems a most discouraging and injudicious enactment of the Legislature, directly militating against every kind of improvement. These carriages are of all others the most destructive to roads, both from their weight, and the exertion of the horses in dragging the machine with the required velocity. But, instead of equitably paying a higher rate of toll, in proportion to the greater wear they occasion, they are not only totally exempted, but, by diminishing the demand for posting, they cut off a principal source of the revenue from tolls. It has been said, that some trustees have had it in contemplation to withdraw from the ruinous expense of repairing roads occupied by mail coaches, which cut off so great a part of the funds for such repairs, though occasioning, by their wear, a demand for greater funds. Fortunately, that impolitic exemption has been lately abolished.

Of the Roads in the Highlands of Scotland.

From the wide extent of the Highlands of Scotland, in proportion to their population, and the great stretch of road necessary in order to obtain access to market, either for the productions of their fisheries, or of their thinly interspersed arable soil, it is evident, that such a country could never have been rendered pervious, so as to have its resources brought to avail, by statute-labour, or by money borrowed upon the security of tolls.*

In 1803, therefore, the liberality of Government was extended to the Highlands, for the purpose of giving access to their improvement, by means of roads and bridges. The country to which this bounty is applied, is marked in the maps annexed to the several reports presented to Parliament by the Commissioners,

* In 1788 and 1789, the propriety of the interference of Government to that effect, was strongly pointed out by George Dempster, Esq. of Dunnichen, in his discourses in capacity of director to a Society, about that time instituted, for extending the Fisheries of Scotland.—(See *Living Characters.*)

A grant of money was then given, vested in the hands of respectable Commissioners, apparently altogether unconnected with that part of the country, and acting without fee or reward, who were empowered to grant one-half of the estimated expense of such roads and bridges as should be deemed of general advantage, upon condition of the proprietors of that part of the country, more immediately interested, advancing the other half, and becoming bound to see the work contracted for, fully and sufficiently completed.

The system was wisely contrived. Private interest being thus necessarily embarked in the same bottom with the public fund, less of idle enterprise in design, and less of waste and want of economy in expenditure, was to be expected, than what generally is found to take place in the management of public money.

From the reports of their management given in by the Commissioners to Parliament, they would appear to have executed their trust in a manner highly to their credit.

That they might not engage rashly and unadvisedly in any enterprise, but avail themselves as much as possible of intimate local knowledge, they seem to have determined that motions for roads or bridges should rather originate from the various districts than from themselves: And accordingly, they began with merely publishing every where the powers with which they were invested, and the funds with which they were entrusted. When applications were made, and a strong probability appeared that the half of the expense would be contributed by the applicants, the Commissioners then ordered surveys to be made by skilful engineers, as to the most eligible allignment of the road, and estimates to be given in of the probable expense; upon receiving the returns of which, a duplicate was sent to the applicants, with intimation from the Commissioners, that, so soon as money equal to the half of the estimated expense was lodged by the applicants, the Commissioners would be in readiness with the other half; and they would jointly proceed to take in offers from contractors, according to the allignment, and specifications as to formation, determined upon by the surveyors whom they had appointed. When these terms were complied with by the applicants, the road and bridges were advertised, in terms of the surveyors' specifications. The preferred offerer had to produce sufficient caution for the due performance of his contract; and the applicants for the road were taken bound by the Commissioners to see that the whole was executed in the terms specified, and to incur any additional expense that might accrue above the sum contracted for. *

* The Commissioners, by a liberal and rational construction of their own powers, advanced money from their fund to such proprietors as could give them negotiable security on their estates; even proprietors under entail might have the accommodation.

The

The surveys being all allowed at the expence of the Treasury, the Commissioners considered it as unjustifiable to incur this expense, either where the road applied for seemed to be of no general advantage, or when there appeared little probability of the road being executed by the applicants coming forward with their half of the expense.

In regard to the preference to be given to applications, the Commissioners uniformly had an eye to what was most extensively useful; and in this view, one leading consideration was, whether or not the proposed lines connected with the existing military roads, which extend northward till they terminate at the great vale of the Highlands, where the Caledonian Canal is carried across the island, in the line of the military forts.

No ornament of bridges, or approaches, was allowed.

The gentlemen of the several counties came at first forward to meet the Commissioners, in raising the moiety required to be advanced, by private contributions. But as, upon such a system, the weight of the expense rested exclusively upon the public-spirited, it was soon found necessary to obtain private county acts of Parliament, enabling the counties to assess the lands for the moiety; and, from what has been stated in regard to the county act applied for by Perth, the maxim (no doubt equitable, though difficult of application) seems to be adopted, and may probably become general, that each proprietor should be assessed in proportion to the immediate advantage to be reaped by his lands.

Tolls on some of the roads and bridges, for the reimbursement of the private moiety furnished to meet the public advance, when proposed, were at first rejected by the Commissioners, unless the Commissioners should be empowered to draw *pro rata* of their advance, to be applied to the purposes of their trust. But afterwards, it appears they considered themselves as authorised to concur in their advance for such roads and bridges, provided the purchase-money (at a fair valuation) of the toll or pontage, should be deduced from the moiety to be advanced by them. Such application for authority to levy toll or pontage, seems also not to have been objected to, on condition that a certain proportion of the revenue was to be set aside exclusively, for the purpose of upholding the road or bridge.

Under the salutary operation of these regulations, it appears from the report in April 1809, that there had then been contracted for, 358 miles 41 yards of road; and securities for the county

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The Commissioners complain of their having felt it unavoidable, in their responsible situation, to give the contract always to the lowest offerer, through which, frequently, distress unavoidably arose, which they could not remedy, though they frequently regretted it. To insist rigorously and invariably upon the exact fulfilment of the specifications, they found indispensable. And it were well, if, in all contracts under public trusts, such uniform rigour were to do away every reliance upon lenity; bating, no doubt, allowance for such accidents as could not possibly be foreseen.

moieties brought forward, for 227 miles 552 yards; for which, of course, contracts had been advertised;—in whole, executed, executing, and in course of being instantly set on foot, 585 miles 593 yards, together with their corresponding bridges.

In 1810, an act was passed for keeping these roads in repair, by an assessment, not exceeding 1s. the pound Scots of valuation. Commissioners of Supply were directed to settle what districts of the county were bound to repair particular roads; or, if the county at large was bound. The road was then made *indictable*. It was competent for any Commissioner of Supply, within each county possessed of 200*l.* valuation, or for any five in a neighbouring county possessed of 200*l.* valuation each, to apply, by summary petition and complaint, either to the Sheriff or Court of Session, who are authorised to inquire into the repairs necessary; to order them; and to assess the county, or the part of it liable, for them.

Canals afford a still greater facility of communication than roads, where they are practicable. There are four inland canals in Scotland for public communication.

The Forth and Clyde Canal, cutting across the island from sea to sea, betwixt the Firths of the rivers Forth and Clyde, was the first in Scotland; and, excepting the Caledonian Canal, was the one upon the most extensive scale of any in Great Britain. It is 35 miles in length; in depth exceeding 8 feet; and, in breadth, and size of locks, admitting the passage of vessels drawing not above 8 feet of water, and not exceeding 19 feet of beam, nor 73 feet in length. It rises to the height of 160 feet, by means of 39 locks, viz. 20 on the east, and 19 on the west of the summit, the tide not ebbing so low in the Clyde as in the Forth by 9 feet. It is carried through all kinds of soils, over valleys, and up precipices; it passes over 15 aqueduct bridges of note, besides small ones and tunnels; and it is crossed by 18 drawbridges. It was begun in 1768, by subscription; but the work was suspended from the exhaustion of the funds, in 1775. It was resumed in 1784, upon a loan to the company from Government, of 50,000*l.* from the forfeited estates, to be applied, when replaced, to roads in the Highlands, and was finally completed in 1790, having cost in whole about 200,000*l.* For a long time, it was an unprofitable concern; the Government loan has been, however, paid up, and it is said now to yield about 15 *per cent.* upon the shares. It establishes a communication betwixt the grain counties on the east coast of Scotland, and the manufacturing ones on the west.

The Caledonian Canal, when completed, will also join the two seas, running from the Moray Frith, on the east of the island, to the great arm of the Western Ocean, called Linne-Loch, along the line of the military forts, *George*, *Augustus*, and *William*, in Inverness-shire,—a line of direction pointed out by nature for an inland canal, being a long valley, occupied, for the greater part, by the natural navigable canals of Loch Ness, Loch Oich, and Loch Lochy. It is upon a scale by much too grand for private undertaking, and is executed entirely at the expense of Government; the expense is computed to be about 800,000*l.*; its profitable use is not likely to be adequate in any degree to the expense. It is 20 feet deep, 50 feet wide at bottom, and 110 at top; the locks are 20 feet deep, 170 long, and 40 broad. Frigates of 32 guns, and merchant ships of 1000 tons burthen, will be able to pass through it. One great intention of the work is understood to have been, that of giving employment at home to those of the Highlanders, who would have emigrated. And probably, many who may have thus been initiated into industrious habits, will continue to exercise them, in other parts of the country, where there may be a demand for labour, when this employment shall have ceased.

The Crinan Canal cuts across the peninsula of Kintyre, and abridges a voyage from the West Highlands and Hebridian ports to the river Clyde, by 200 miles. It is in length 9 English miles; its depth 12 feet; and its breadth sufficient to admit vessels of 160 tons burthen. It cost 140,000*l.*; but the toll-duties would seem insufficient to keep it in repair, and the use would seem inadequate to the expense.

The Ardrossan Canal is to run from Glasgow across Renfrewshire, and the north part of Ayrshire, to Ardrossan at the mouth of the Firth of Clyde.

Some few other canals have been projected; but their execution has been suspended.

It is well remarked by Smith, in his *Wealth of Nations*, (and the remark is equally applicable to iron rail-ways), that canals may safely be left upon the footing of private property; because, if allowed to get into disrepair, they are immediately unnavigable, and the revenue from them ceases. Not so public highways, which do not cease to be travellable or travelled, though in very wretched repair, and of course the revenue from them continues. Highways ought, particularly upon this account, never to be placed under the administration of Government. Some great roads, coming under the eye of foreigners, might be maintained in a high degree of splendour: those attracting less notice would be neglected, till the revenue from them failed, from their becoming totally impassable: nor would it be an easy matter to call the officials of the administration to an account.

Iron rail-ways, (excepting a few, carried to very short distances, and merely for the accommodation of private coal, lime, or iron works), have been but of late thought of in Scotland.

The only one that has been executed, of any considerable length, is the one from Kilmarnock, in the county of Ayr, to

Troon Bay, in the mouth of the Firth of Clyde, a distance of about 10 miles.

There is another in agitation at present, to go betwixt Glasgow and Berwick, at the computed expense of 365,000*l.*, which would establish a communication for interchange of the coal, lime, manufactures, and colonial produce from the west, and the corn from the eastern and intermediate districts. It is uncertain whether this one may not be superseded, as to considerable part of its use, by the one from Kelso to Berwick, for which an act of Parliament was obtained this session. The length of this last is 23 miles, and the estimated expense 77,709*l.*

Iron rail-ways would seem to afford a means of communication, perhaps equally advantageous as that of canals. By the experiment exhibited by Mr Wilkes of Measham, in Leicestershire, before the Society for encouraging Arts, a horse of 20*l.* value, drew, upon a rail-way, declining 1 foot in 100, 32 tons easily, and 43 without much difficulty, dragging it down hill; and 7 tons going up hill, independent of the weight of the carriages. Both would seem to possess their respective advantages and disadvantages. Canals might be shut up, in hard frost; whilst iron rail-ways may be locked up, by snow-storm: Canals, carried over low grounds, upon a higher level, may not only occasionally overflow them, but, by their leakage, may keep them in a swampy state.

Expeditious travelling could never be accomplished on canals, or iron rail-ways, and they could not supersede the use of roads; but as all heavy articles would necessarily prefer the more economical carriage, roads might be kept up at a very inconsiderable expense, if canals or rail-ways were general.

Universal internal communication prevents that monopoly of farm produce, which the nearer surrounding circles of the country would, without it, enjoy against the inhabitants of towns. It introduces universal competition, and, of course, universal improvement of industry. †

SECT. III.

OF THE PRODUCING INDUSTRY OF MINES AND FISHERIES.

ACCORDING to the classification of industry, stated in Sect. I., agriculture, mining and fishing are ranked under the head of *producing industry;* inasmuch as, from them, are derived the means of subsistence and the materials of manufacture, without which the other classes could neither exist nor become possessed of the subjects upon which their industry is exercised. Having, however,

† Dr Smith (Wealth of Nations, Book I. Chap. xi.) notices, that, about the beginning of last century, some of the counties in the neighbourhood of London, petitioned against the extension of turnpike roads into remoter counties.

in the last Section, treated at large of the various political arrangements which equally affect all kinds of industry, our observations upon the subjects of this and the following Section will be short.

1. *Of Mines.*

Coal and *Lime*, articles so essential to the prosperity and improvement of a country, considerably abound through Scotland; and it is to be hoped, that, through the gradually improving facilities of intercourse, by means of roads, canals, and iron railways, they will become more and more generally accessible, so as to allow proper advantage to be made of the natural resources of every part of the kingdom, and of the disposition of the inhabitants.

The subject of coal affords an instance of the progressive nature of the science of finance, requiring, like all others, time and experience to bring it to maturity. The first occurring rude idea of taxation is, to impose it where it merely promises to be productive. Accordingly coal, water borne, was long subjected to a tax in Scotland, enhancing the price of this indispensable article to those to whom it came dearest, at any rate, from its distance. Through a more enlightened system of policy, this injudicious tax, pressing hardest where there was least capacity to bear it, (the hardships of which were placed in the strongest light, by the observations of the Clergy, in the printed Statistical accounts of their respective parishes), has been repealed.

Freestone, from Milnfield in the shire of Angus, has been used in constructing the London, or West Indian Docks. *Whinstone* from Salisbury Craigs, in the neighbourhood of Edinburgh, carried economically as ships' ballast, has been used in paving the streets of London. A premium was awarded, by the Society for encouraging Arts, since the commencement of the French war, for the discovery of a species of *millstone* in Aberdeenshire, of a quality approaching to that of the French burrs. Specimens of *marbles* have been brought from the Highlands of Scotland. *Slates* are wrought, both in the Highlands and Lowlands; and these, with tiles, are coming more and more to supersede the use of turf and of straw, for covering roofs, to the considerable saving of surface soil for culture, and of straw for manure.

Mines of lead are wrought at Strontian, in the Highlands; and at Leadhills and Wanlockhead, on the confines of Dumfries-shire, *Ironstone* abounds; and where there is ready access to fuel, iron is successfully manufactured, in Stirlingshire, in Clydesdale, and on the confines of Ayrshire.

Nothing observable occurs, as to fiscal or political regulations, in regard to the industry employed upon mines or quarries, either in the way of encouragement or of obstruction. It is left to feel its own way, and to rest on its own bottom; to reward itself by its own fruits.

2. *Of Fisheries.*

The fisheries that have attracted most attention, as being of most importance, are those of salmon and herrings, and latterly, of whales.

That industry may have its proper excitement to augment in quantity, or to improve in quality, those subjects which it is capable of augmenting or improving, an exclusive right of property, in the subject to which it is applied, is indispensable. A sense of common interest in protecting such exclusive appropriation is evolved,—in regard to domestic animals, so soon as the chase is left off for pasturage,—and in regard to soil, so soon as recourse is had to its cultivation. Fisheries in general, being unsusceptible of such augmentation or melioration, the grounds of their exclusive appropriation are not so obvious; and here, therefore, the law, instead of following and giving sanction to a natural sense of right, as in most other instances, constitutes the right itself, entirely by its own enactments.

No individual ever dreamed of exclusively appropriating the open sea, with its products, or even an arm of the sea, which remains, therefore, in common, for common use. And a river, of such size as to afford salmon-fishing to any considerable extent, is an object of too great magnitude, (particularly as it widens into a firth), to be conceived by the imagination as an accessory or appendage to the landed estates it may pass through; or, however the river may be appropriated, on being construed as an appendage to conterminous lands, still the fish of the river are a common property to *its* proprietors. There is a necessity of regulation, in river, as well as in sea fishing, that the common use may be employed without mutual obstruction, or deterioration of the common subject.

Salmon-Fishing.

It is the peculiar instinct of the salmon tribe, of migrating from salt water to fresh, to deposit their spawn, and from the fresh again to the salt, for the sake of food; circumstances which place them under the command of man.

It is much in the power of those situated at the mouths of rivers, to intercept the fish in their passage upwards, so as to deprive those situated above of their share of the benefit, as well as to prevent the multiplication of the fish, in keeping them from the shallows where they spawn; whilst those upon the superior parts of the river, and smaller brooks running into it, might greatly thin the breed, by destroying the fish come up for the purpose of spawning. The regulation of a common property, where the irregular exercise of the use might be so mutually obstructive, as well as destructive of the subject, has been anxiously provided for by many acts of the Scots Parliament.

There are many enactments for preventing salmon from being destroyed in spawning time, and their young fry when descending to the sea.* Some of these are sufficiently severe; the act of 1503 makes the penalty for the first offence 10*l.* Scotch, for the second 20*l.*, and for the third death: arbitrary corporal punishment is, however, remitted in the latest enactments. There are also various acts and re-enactments, to prevent the interception, at the inferior parts of rivers, of the salmon in their ascent: As, that a mid-stream shall always be kept free of obstruction, the open passage being so wide that a swine of three years old, well fed, may turn himself round within it, (stat. Alex. II.)—a space defined, in subsequent statutes, to be six feet; that a slope shall be kept open in cruives on Saturdays, and that no salmon be taken from Saturday, after evening song, till Monday at sunrise. Enactments also appear, authorising the destruction of all cruives, yairs, and other instruments of interception, *that are set of late*, or *where the charter of the adjacent lands do not contain express enfeofment of salmon-fishing*. So that the right of salmon-fishing, and the mode in which that right is to be exercised or limited, is to be interpreted, partly from *consuetude*, and partly from *written record.*

There has not occurred a more fertile subject of litigation than the right of salmon fishing. And the right to fish, and the mode of fishing competent to each proprietor, whose lands comprehend, or are bounded by the river, has had to be ascertained by as many distinct separate law processes, in regard to almost all the Scots salmon-fishing rivers.†

Herring Fishery of the Hebrides, and Western Coasts.

The herring fishery, on the western coasts of Scotland has always been considered as of more importance than that of salmon; by some, indeed, as something incalculably great. It has, however, never yet realized, in the most trifling degree, those expectations that have been formed from it.

As a subject of common right, unfit for individual appropriation, the joint use would seem to stand in much need of a system of well enforced regulations, to prevent the abuse of the subject, and the mutual interference and interruption of the occupiers. It is complained, that the too eager haste to attack the herring shoals before they have completely entered the lochs, and the ruinous

* Irrigation was found, or reasonably apprehended, to be destructive to the salmon of the river Tweed. In the numerous water-meadows formed upon the sides of rivulets running into that river, in the Duke of Buccleuch's lands, it was found that the salmon fry, in their passage down to the sea, often entered into the main feeders, and passed on by the smaller feeders, till they were left entangled and exposed among the grass on the panes, where they were devoured by the fowls. Upon a representation to his Grace, tirlaces of wire were placed upon the mouths of the main feeders, to prevent them from entering.

† Hutcheson's Justice of the Peace.

practice of setting nets in daylight, scares the animals, naturally timid, and drives them out again to the open deep sea, putting an end, of course, to the boat-fishing of the natives: That in the eagerness to have the nets placed in the most favourable position, they are often crossed, so as to prove mutually obstructive: That the boats of the larger vessels, trusting to the superior strength of their crews, often maliciously carry off the buoys, and cut the nets of the boat-fishers, whilst the large vessels often steer across their nets, in order to obstruct the boat-fishing, and to monopolize the whole shoal to themselves. Complaints are also made of the want of a proper system of intelligence, to give warning of the arrival of the shoals of fish, &c. ‡

Regarding it as an extensive nursery for seamen, and a source of profitable occupation for the overflowing and unproductive population of the Highlands and Islands, Government has attempted to push forward the herring fishery, at much expense, and, hitherto, to little purpose.

Smith, in his Wealth of Nations, (Book IV. Chap. v.) states, that in the eleven years, from the commencement of the winter fishing in 1771, till the termination of the fishing of 1781, the herring buss fishery (including the bounty on tonnage, the loss of duty upon the salt used in curing the fish, and the bounty of 2s. 8d. on every barrel exported) has stood the public, in expense per barrel, of those cured with Scots salt, 17s. 11¼d. on every barrel exported, and 14s. 3¼d. on each barrel entered for home consumption; of those cured with foreign salt, 1*l.* 7s. 5¾d. on each barrel exported, and 1*l.* 3s. 9¾d. on each barrel entered for home consumption; whilst the market price of herrings he states at the medium of 1*l.* 1s. per barrel; that is to say, Government had paid about the whole market price of the commodity, as a bounty upon its production. A tonnage bounty, he observes, proportioned to the burden of the ship, and not to her diligence or success in the fishery, has, it is to be feared, made it too common for vessels to fit out for the sole purpose of catching—not the fish, but the bounty. And accordingly, in 1759, when the bounty was so high as 50s. per ton, he states the whole buss fishery to have brought in only four barrels of sea-stickys, (that is, herrings salted at sea, but needing resalting and repacking before being fit for the market); which cost Government, in the mere bounty alone, at the rate of 113*l.* 15s. for each barrel of sea-stickys; or 159*l.* 7s. 6d. each barrel, when reduced in size by repacking, so as to become merchantable herrings. †

‡ Survey of the Hebrides, by the late Mr James Macdonald; an excellent work, giving by far the best account of those remote districts.

† The following quotation from the same author, (Book IV. Chap. v.) shows of how little real advantage such extravagant bounties are to the undertakers,—particularly when bestowed on the mere undertaking, and not proportioned to the

In an ingenious essay sent to the Highland Society by Mr Headrick, the commonly received notion of the herrings migrating to the frozen sea in winter, and moving to the southern warmer latitudes in summer, (so contrary to the analogy of all other known animal migration), seems successfully combated; and, from facts in point, the migration of herrings is shown to bear some analogy to that of salmon, being, though not from salt water to water absolutely fresh, yet from salter water in the deep sea, to brackish or fresher water in the lochs, whither they seem also attracted, from the higher temperature of the shallower

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the actual success,—though, if given extravagantly, even though limited to success, it makes a smaller measure of success suffice to yield a satisfactory profit, and supersedes the necessity of the most vigorous exertion.

Having noticed that bounties have not lowered the price in the home market, he goes on to observe:

'When the undertakers of fisheries, after such liberal bounties have been 'bestowed on them, continue to sell their commodity at the same, or even at a 'higher price than they were accustomed to do before, it might be expected 'that their profits would be very great; and it is not improbable that those of 'some individuals may have been so. In general, however, I have every rea'son to believe they have been quite otherwise. The usual effect of such 'bounties is to encourage rash undertakers to adventure in a business which 'they do not understand; and what they lose by their own negligence and ig'norance, more than compensates all that they can gain by the utmost liberality 'of Government. In 1750, by the same act which first gave the bounty of '30s. the ton for the encouragement of the white herrings fishery, (the 23d 'Geo. II. chap 24.), a joint stock company was erected, with a capital of '500,000*l*., to which the subscribers (over and above all other encouragements, 'the tonnage bounty just now mentioned, the exportation bounty of 2s. 8d. the 'barrel, the delivery of both British and foreign salt, duty free) were, during 'the space of fourteen years, for every 100*l*. which they subscribed and paid 'in to the stock of the Society, entitled to 3*l*. a year, to be paid by the Receiver 'General of the Customs, in equal half-yearly payments. Besides this great 'company, the residence of whose governor and directors were to be in Lon'don, it was declared lawful to erect different fishing-chambers in all the dif'ferent outports of the kingdom, provided a sum not less than 10,000*l*. was 'subscribed into the capital of each, to be managed at its own risk, and for its 'own profit and loss. The same annuity, and the same encouragements of all 'kinds, were given to the trade of those inferior chambers, as to that of the 'great company. The subscription of the great company was soon filled up, 'and several different fishing-chambers were erected in the different out-ports 'of the kingdom. In spite of all these encouragements, almost all those dif'ferent companies, both great and small, lost either the whole, or the greater 'part of their capitals; scarce a vestige now remains of any of them; and the 'white herring fishery is now entirely, or almost entirely, carried on by private 'adventurers.'

The same fate seems to have attended a joint-stock company for extending and improving the Scots fisheries, erected about the end of the American war, and in which a leading part was taken by the patriotic George Dempster, Esq. of Dunnichen. After purchasing lands, building villages at the fishing stations, &c. the company stock, amounting probably to about 150,000*l*., is, if not totally annihilated, at least dead; and, instead of being possessed by industrious inhabitants, the fishing villages are filled with idleness and profligacy. In the well founded opinion of the author of the Wealth of Nations, joint-stock companies are inadequate to the management of any business, but a mere business of routine.

water, for the purpose of depositing their spawn. The analogy to salmon seems also to hold in herrings, in the circumstance, of a distinct character of herrings being ever found in the same lochs, just as salmon of distinct characters frequent each their appropriate river. Hence the conclusion seems not improbable, that herrings may not only be catched in lochs, but that, at all times, the same herrings may be found in the deep seas, in the near vicinity of those lochs which they regularly frequent. To ascertain the reality, and, if found real, to reap the advantage of this deep-sea fishing, as a more constant subject of industry than the loch fishing, the bounty upon tonnage is now confined to larger vessels, equipped for the deep-sea fishing; though, from what has been stated, the expediency of any bounty seems very questionable, and that upon mere tonnage the most inexpedient of all.

The boat-fishing still shares the advantages of the drawback of the duties upon salt; but this indulgence, it is said, serves to raise up an host of smugglers, who obtain the salt, duty free, under pretence of applying it to the curing of fish, but who in fact sell it to be employed for various other purposes.† It is represented, at the same time, that the regulations to prevent smuggling of the salt, given duty free, are so extremely complicated, that those who intend *bonâ fide* to use the salt in curing fish, may lose altogether the opportunity of fishing, before the forms can be gone through; and when the fishing is over, that vast distances must sometimes be travelled, in order to render the account of the salt at the office required: Meantime, a crowd of officers, having an interest in forfeitures, are ready to embarrass the forms, that compliance with them may be more difficult, and forfeitures more readily incurred, and to impute forfeitures where none have in reality taken place; and that these causes, tried before Justices, who pretend not to comprehend the verbose diction of acts of Parliament, are generally decided according to the interpretation put upon the law by those that pursue for, and have an interest in, the forfeiture.*

The ingenious author of the survey last mentioned, proposes a scheme in regard to the salt, which would make a total alteration of the whole system of the fishery, but which would tend to remove much present inconvenience and obstruction to that species of industry.

He proposes that government warehouses of salt, well stored

† See the valuable and spirited Report of the Counties of Ross and Cromarty, by Sir George S. Mackenzie, Bart, p. 316.

* A gentleman-farmer of a keen and anxious temper, was laid under the necessity of short absences from home, from an office he held: on departing, he was in use to leave minute written directions as to every part of work, to his servant. Upon his return, nothing was done. The whole time of his absence had been taken up in studying the voluminous code of instructions.

with that article, should be kept at all the fishing stations; that no salt should be delivered to those who apply for it, but upon paying down the whole price, duty included; that, at the end of the fishing, the salt unused should be allowed to be returned, and the same price repaid that had originally been paid for it; that a deduction of the salt duty should be allowed upon every barrel of cured herrings produced, and no doubt that the barrels on which deduction was claimed should all be produced at one time; to prevent the fraud mentioned in the survey, of taking out the stave of the barrel which had been branded with the inspector's mark, and replacing it with a new one, and presenting it over again as a different barrel. It might perhaps be added, that the whole bounty should be upon the barrels, and none on tonnage, that encouragement might be thus only given to actual execution, and none to the mere show of engaging in the business.

In this way it is conceived all smuggling of salt would be effectually prevented; there would be no complicated forms to embarrass the fisher, who might follow out the business with undivided attention; and an host of excisemen, interested in still more embarrassing the forms, to occasion forfeitures, might be dismissed. This, with proper regulations to prevent the abuse of the subject, to preserve order, and prevent mutual obstruction in its common use, together with the establishment of a proper mode of conveying intelligence of the arrival of the shoals, is, it is contended, all that is required.

No doubt the advancing of the price of the salt would drive out of the trade those curers who had not sufficiency of capital. But this effect is not to be regretted, but desired. It would lead, as in all other business, to a proper subdivision of labour, so indispensable to the perfection of work. The present boat-fishers and curers would be employed in mere fishing, by the capitalled undertaker; though perhaps, at first, from few capitalists starting at once, there might exist a monopoly of purchase against the boat-fishers, who would in that case most unquestionably be oppressed, while their employers made enormous profits; yet this very circumstance would the sooner bring other capitalists into the competition of a trade so gainful; and the extent and speediness of relief would be exactly in proportion to the extent of the temporary oppression suffered. From the superabundance of capital at present unemployed, the whole of these consequences would very speedily be realized. It is, however, evident, that, to the accomplishment of these objects, it is indispensable that the trade should be perfectly free, and that every idea of exclusive companies must be rejected.

Much of the funds, both of Government and of individuals, have been already sunk, without return or prospect, upon the herring fishery. And nothing can apologize for the waste incurred, but the anxiety to procure a nursery for seamen, at a cheaper rate than by a standing navy: where, too, the mere service of parade could never be expected to produce that hardihood, and presence of mind in the midst of danger, which may be expected to be acquired in the course of strenuous enterprize, inspired by the hopes of gain.

It seems, however, very questionable, whether any quantity of seamanship has ever been created by the herring fishery,—and whether what is found doing no good in it, would not have existed profitably elsewhere, and has merely been attracted to it by the force of extra encouragement. Laying open the East India trade, would be a measure of much more efficacy; whilst, instead of proving a source of expense to the public, it would relieve it from the oppression of monopoly.

SECT. IV.

OF MANUFACTURES AND COMMERCE.

IT is evident, that artificers of conveniencies, or negotiating merchants, cannot exist, but in proportion as agriculture, foreign or domestic, provides the means of subsistence. It is equally evident, that cultivators of the soil could have no rational inducement to provide a surplus produce, above what suffices for their own support, unless as the material of exchange against such conveniencies as they prize.

The great business of society, (the raising of the greatest quantity of the means of subsistence and conveniency, and the proportional distribution of these through the whole body of the people), depends upon the mutual stimulus given to each other by manufacturing and agricultural industry, and the facility of the mutual interchange of their products through the industry of commerce.

The immediate object of attainment held in view by the whole industrious classes, is the possession of the precious metals; but these, of all the metals, are the most unimportant to human life, for any essential purpose of accommodation or defence; their only use, in this respect, is, the trifling one of mere ornament; it is as the agreed common measure of value that they are prized, and as giving, in this capacity, the command of both necessaries and conveniencies, which, if they could not purchase, they would be perfectly insignificant. Of course, the whole industrious exertions of the population are ultimately resolvable, as to their exciting motive, into the desire of obtaining necessaries for conveniencies, or conveniencies for necessaries, in the way of mutual exchanges, the only way in which, through mutual subserviency in the subdivision of labour, they can be obtained in abundance and perfection, so long as self-interest shall continue to be the steady and prevailing motive to human action.

I have already stated (in Sect. I.) the perilous and precarious state of a nation of mere manufacturers or merchants, dependent for the means of subsistence upon the agriculture of foreign nations, and the approach which is made to that state, when, by extra encouragement given by government, manufactures and commerce are made to start before, instead of keeping pace with, domestic agriculture, and capital is attracted from the latter to the former. The excess to which manufactures and commerce are thus carried, and the extent of dependence upon foreign agriculture, to which the nation is by this means reduced, may be estimated by the average excess of the import above the export of grain, and the proportion of this excess to the probable whole national yearly consumption of grain.

Besides the injury done to agriculture, and the dependence brought upon the nation, through the overweening anxiety of the Legislature to encourage manufactures and commerce, it might further be observed, that the latter species of industry may sometimes be hurt by an over anxious nursing care. The child that is kept constantly in swaddling-bands, will never acquire the use of its own limbs; and where minute regulation leaves no room for liberty of thought and action, it is in vain to expect the exertion of spirited enterprise. Minute regulations of trade may, in this respect, be compared to prescribed modes of management in leases. In a former Note, Sect. II. p. 208 *& seq.*, I have adverted to the regulations of our Scots favourite linen trade; as also, to the regulations of the favourite English woollen trade, for ensuring perfection of work, &c.; which latter, after being in non-observance for more than half a century, in some of the more extensively manufacturing districts, were at last, as to those districts, formally repealed by Parliament in 1803. It is probably owing to this over anxious nursing care, that the linen manufacture of Scotland remains trifling and inconsiderable, in comparison of that of cotton; which latter has happily escaped the fetters of minute interference of regulation. Had regulation been equally applied to the latter as to the former, that maternal solicitude, which has guarded, by express statute, against exposing a linen web to the harsh action of lime and of pigeon's dung, would never have suffered the thin texture of a piece of muslin to be subjected to the risk of being passed over a red-hot cylinder of iron,—a manipulation by which our Scots manufacturers of cotton proposed to give a smoothness to their fabrics, to rival those of the East Indies.

The following statements, from the second volume of Chalmers's Caledonia, may be amusing, though not of much importance.

The quantity of linen manufactured in Scotland, is easily ascertained, as it must all undergo the examination of an appointed inspector, and even receive, from his stamp, a sort of coinage, authoritatively ascertaining both its quantity and fineness, before it is entitled to currency in the market. As to other manufactures, happily unsubjected to the interruption of such minute interference, though of much greater magnitude and value, no accurate statement can be given.

1st, *Table of Linen Manufactured for Sale.*

	Yards.
Manufactured in Scotland, at the date of the Union of the two kingdoms, - - -	1,500,000
When Commissioners were established for encouraging manufactures and fisheries in 1727, -	2,183,978
In the year 1801, - - - -	25,271,155

The value of the last supposed 1,018,642*l*.

2d, *Table of the Value of Scots Exports.*

In 1755, - - -	L. 284,700	18	1
Average of five years ending in 1760, -	375,057	7	0
Ditto of ditto, ditto, 1770, -	451,170	14	10
1780, -	549,375	9	11
1790, -	769,296	6	11
1800, -	1,402,650	0	3
1801, -	2,449,171	4	6

3d, *Table of Scots Imports and Exports.*

	Imports.			Exports.		
In 1755, - -	L.464,411	11	7	L.535,576	16	4
In 1801, - -	2,579,944	8	10	2,844,502	4	0

In regard to the export and import of grain, it appears from Mr Chalmers's statements of averages of five years, that from 1707 till 1762, the exports exceeded the imports, at the rate of from 7022 quarters (the lowest average of excess), to 57,522 quarters (the highest average excess). And that from 1762, the imports have exceeded the exports, at the rate of from 16,300 (the lowest average excess), to 153,709 quarters (the highest average excess.)

4th, *Table of Scots Shipping.*

The following state of Scots shipping in 1800, is from the second volume of Chalmers's Caledonia:

	Ships.	Tons.	Men.
Foreign trade, - - - -	687	81,907	5589
Coasting ditto, - - - -	1169	66,133	4731
Fishing ditto, - - - -	559	23,688	4500
Totals, -	2415	171,728	14,820
Employed in 1806, - - -	2788	211,431	

The same for 1760.

	Ships.	Tons.	Men.
n trade, - - - -	454	35,067	3709
ng ditto, - - - -	432	15,004	1557
g ditto, - - - -	113	3,842	677
Totals, -	999	53,913	5943

SECT. V.

OF THE POOR.

considerable proportion of the human species will ever be n a state of helpless indigence, from total incapacity to their own wants by their own exertion—and that is the who are in the sate of infancy or nonage. A kind pro- is made for the relief of this dependent portion, by the r of Nature, in implanting the strong instinctive affection ental love; which, when ascertained of its appropriate by the laws of chastity and of marriage, (institutions co- d coexistent, in a prevailing degree, with the human race), he parent to identify the child with himself, and to attend oncerns with all the zeal of a personal interest. Filial af- may also constitute a like provision for relief of that un- but less numerous portion, who are reduced to the same on of dependent indigence, through the failure of active , the concomitant of old age. In conformity, however, e general system of Providence, in which one thing is r against another in due measure and proportion, ascend- ection is experienced to be of considerably less intensity hen it descends; * because there ought to be less demand in this direction, if due use were made of those powers sight, through which, in the season of mature vigour and provision ought to have been laid up against the season y and failure.

le men, in a savage state, subsist upon mere natural pro- neither augmented nor ameliorated by the industry of cul- nd where, of course, the utmost exertion and fatigue of rrived at the full maturity of their powers, is often barely nt to procure their own mere personal subsistence. The on even for the first mentioned portion is but precarious; n are often deserted and left to perish, in seasons of un-

cession by inheritance follows the course of natural affection; and the im, *Heræditas, sicut ponderosum quid, descendit semper linea directa a, raro vel numquam ascendit*, may be considered as marking the cur- affection.

successful hunting, the affection of parental tenderness being forced to give way to the still more imperious call of self-preservation. And for the aged or permanently infirm, there can no other provision be afforded, but a relief, through speedy death, from the tedious torture of dying by hunger, or being torn to pieces by beasts of prey. In civilized society, the superior productiveness of subdivided but cooperative labour can afford a surplus, above the subsistence of the labourer himself, to make abundant provision for all *necessary* indigence; if only no *artificial* indigence were created by the absurd policy of poor's laws, in holding out a prospect of provision independent of industrious exertion,—thus superseding that provident foresight which ought to ward off want, and the exercise of both parental and filial affection for its relief when it occurs—encouraging also that prodigality of procreation which is unchecked by any reference to consequences, while the view is absurdly directed for resource to that nonentity or mere abstract idea of *the public*, as if *the public* had any real existence distinct from that of the individuals that compose it, or any funds distinct from those created by the industry of those individuals.

The charity of Monasteries was the most early provision of the nature of a poor's law; encouraging beggary and idleness, in offering a resource independent of industry, economy, and prudent forethought; † in its effects, however, still less hurtful than a direct legal provision; as such charity might remain in some degree voluntary, and could not be claimed as a valid right. Upon the dissolution of monasteries at the Reformation, that mass of dependent indigence which their charity had raised up, was deprived of its support; and society was inundated by helpless beggary, occasioned through want of providence, or intimidated by stout idleness, which reliance on monastic charity had prevented from acquiring, and rendered reluctant against acquiring, industrious habits: And out of mistaken humanity, recourse was had to poor's laws—not of a temporary kind to give immediate relief, but perpetual, to the effect of perpetuating the evil.

England took the lead of Scotland, as in the Reformation, so, in the establishment of a poor's-law system; and in Scotland, upon the dissolution of her monasteries, measures for the relief of the indigent were likewise adopted.

The act 1579 contains the first attempt at a system, for both punishing vagrants, and at same time making provision for such poor as were real objects of charity; and subsequent acts continue to conjoin both these objects in the same enactment.

By this act, the vagrant, upon conviction by an assize, was ordained to be imprisoned, so long as he had any thing of his

† For these effects of Monastic charity, see Townshend's Travels in Spain.

own to live upon; then to be whipped, and burnt through the ear with a hot iron, unless any householder would consent to take him into his service, under bond to present him again at the end of twelve months, or bring proof of his death; and if the vagrant should escape from his service, he was immediately to be punished as before mentioned; and if, after sixty days, he should be found again at his old trade, he was to suffer death as a thief. This sanguinary law, homologated in many subsequent enactments, has been superseded by the milder general British statute against vagrants.

The various enactments in regard to the support of real objects of charity, are not very consistent; and, had some of these enactments been carried strictly into execution, Scotland might now have laboured under the same grievance as England, from the oppression of her poor's laws. The present existing system has been matured by repeated decisions of our Supreme Court, founded partly on Scots acts of Parliament, partly on the authority of Royal proclamations, and the reason of the thing. It may be proper to state, 1. The *funds of supply:* 2. The *providers of the funds:* 3. The *administrators;* and, 4. The *rights of the poor.*

1. *The funds* consist, sometimes, in part, of mortifications (bequests), in money or in land, destined for that purpose, by persons probably more well disposed than enlightened.* The other ordinary funds are, voluntary collections given at church-doors, with some small dues (standing merely on the authority of custom) at marriages and baptisms, or for the hire of a litter, a hearse, or a pall or mortcloth (kept by the kirk-sessions), at funerals. When these funds are found inadequate, the deficiency is made up by an assessment upon the lands,—the one half paid by the proprietor, the other by the tenant. In towns, stent-masters assess the inhabitants for that purpose; sometimes (as in Edinburgh) the assessment being proportioned to the house-rent of the occupier, or (as in Glasgow) according to supposed wealth.

2. *The providers* of the funds to supply deficiencies, are, in all country parishes, the heritors. The tax is therefore exclusively imposed by those who, immediately, and through their tenants, bear the burden. †

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* From the bad tendency of such bequests in begetting reliance, independent of personal exertion, the propriety has been suggested of rendering all such appropriations illegal.

† It would seem that, in England, landed proprietors, when they do pay any part of poor's rates, pay only a certain fixed sum, tenants who have leases being taken bound to pay all extra assessments, and those who have no leases not daring to refuse. As the landholders do not *immediately* feel the pressure of poor's rates, this may account for the want of redress. The old English barons, though extremely reluctant to submit to taxation themselves, were little scrupulous in allowing their sovereigns to levy taxes upon the occupiers of their lands, not perceiving that these must fall ultimately upon themselves, in diminution

3. *The administrators* of the fund are, the minister and elders (or kirk-session). The care of the poor is considered as a duty incumbent upon them, not as an office from which any emolument is to arise. The administration, therefore, costs nothing, excepting that, sometimes, a small allowance or percentage upon the assessments is made to the clerk, for trouble of apportioning and collecting them. The kirk-session, composed of elders, (chosen ordinarily from among the most respectable inhabitants of fixed residence, and residing heritors), and the minister of the parish, are accountable for their proceedings to the meetings of the heritors of the parish, excepting for the one half of the ordinary collections at the church-door, which is placed entirely under the control of the kirk-session, to meet unforeseen occurring exigencies. When the ordinary funds are found deficient, and a parochial assessment becomes necessary, a meeting of heritors is intimated from the pulpit on Sunday, by the authority of the kirk-session, upon the *induciæ* of ten free days. † The heritors who meet upon this citation, have full powers of law to assess the proprietors of land and their tenants, for the poor; the assessment to be proportioned to the respective valuations of the lands in the county cess-books: the heritors attending, vote *per capita*. When they meet, they can call for an account of the session's administrations, and are competent to recover from the members of session such funds as they may have lost or misapplied, by a process before the ordinary courts of law. At these meetings, the kirk-session has no power of placing any person upon the roll, or in modifying the *quantum* of pension to be assigned: they have no right of interference, but simply that of representation and advice. When the heritors, with the advice of the minister and kirk-session, have made up a list of the poor,

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nution of rent. It is certainly a fundamental constitutional principle, that those who impose a tax should have a fellow-feeling of its burden. In some instances, in Scotland, proprietors have imposed the whole burden of poor's assessments upon their tenants, in direct contradiction to act of Parliament, which makes proprietor and tenant liable in equal shares. It may be questionable, how far such conditions are not *pacta illicita*; unless it were also articled, that those who alone pay should have the sole right of voting in the imposition of what is paid.

In 1795, the parish of Gettering, in Northamptonshire, was assessed for the poor at the rate of 15s. in the pound of racked rent. Suppose, then, a landed proprietor had his lands let to tenants at 1000*l.* a year of rent, these tenants had actually to pay, over and above, 750*l.* to the overseers of the poor.

The inequality of this tax is obvious; for had a merchant, a manufacturer, or person possessed of money in the funds, and enjoying a revenue of 1750*l.*, been resident in that parish, he could only have been assessed according to the rent of the house possessed by him, which, at a rent, suppose of 60*l.*, could only have subjected him to the payment of 45*l.*—See *Complete Farmer's Dictionary*, published at London in 1807, in two volumes quarto.

Instances are stated of tenants paying 24s. to the poor upon every 20s. paid to the landlord. (Id. ibid.)

† Non-resident heritors, or their factors, should also get written intimation.

and fixed the pensions which they think proper for the ensuing six months, according to their opinion of need or desert, they then take account of what may probably be considered the eventual amount of the ordinary funds, (bating, as before mentioned, the one half of church-door collections), for the six months to come, and assess for what appears will be the deficiency; remitting to the session-clerk to apportion the sum among the heritors and tenants, (each paying one half), according to the valuations of the lands. If none of the heritors meet, in pursuance of the intimation from the pulpit, by themselves or their men of business, it is perfectly competent for the minister and kirk-session to hold the meeting in their room, to make up a roll, and to assess for the ensuing six months. Where there are no parochial assessments, which is still a very common case, and the kirk-session are entirely entrusted by the heritors with the management of the ordinary funds, still, where the session proceed to any act of extraordinary administration, (such as uplifting and lending out mortified money), they ought to call upon the heritors, and act with their concurrence, otherwise the members of session are personally liable to the heritors, if the money is misapplied or lost.

4. *The right of the poor* to maintenance comes next to be considered, though, in strict propriety of speech, no such right can exist as a right to alms; it is a mere gratuitous claim upon benevolence, and stands not in the smallest degree upon the footing of justice. If a pauper, however, is neglected, it is made competent for him, (and the kirk-session of the parish where he resides will do it for him, if his claim is upon a different parish), to apply to the Sheriff, the Justices, or, in a burgh, to the Magistrates, who, upon his instructing upon what parish his claim lies, will decern him to be alimented by that parish. But though there are many instances of an aliment being thus decerned, there is no instance of any judge pretending to decern the *quantum* of aliment; which is left entirely to the discretion of the parish against which the aliment has been decerned. And it is to be hoped that this long continued forbearance of foreign jurisdictions to interfere with the parochial powers, in establishing the *quantum*, will henceforward be properly interpreted into a want of competency so to interfere. Three years actual residence in a parish, as an useful labourer, independent on any charity, constitutes the legal residence in Scotland; and so long as such a person behaves honestly, and free from crime, no judicature whatever is entitled to put him to challenge, or to interfere with his liberty. * Birth hath nothing to do with residence in Scotland, the child following the condition of its parents.

* 'In the fullest enjoyment of civil liberty,' (says Hutcheson in his Justice of Peace), 'under circumstances that promote the free circulation of labour, 'and

The parochial right of removal is a term unknown in Scottish jurisprudence: the oppression of poors' laws, has, happily, never been so felt as to have suggested such legislative measures of self-defence. Where a person falls into poverty in a parish where he has not acquired a residence, that parish will assist him as they do their own poor, charging their advance against the parish upon which his claim lies; and in this way, the poor are not precluded from retiring to their relations or friends, where they may receive many gratuitous good offices, which must be paid for if administered by strangers, and the solace of that kind attention which money cannot purchase.

From this practical statement of the Scots poor's laws, as ascertained by decisions of the law courts, (which I have collected from Hutcheson's Justice of the Peace *), it appears, that, what-

'and remove the obstacles by which industry is prohibited from availing itsel 'of its resources, the Scottish artizan or labourer may, at his own discretion, 'change his abode without challenge or control, if only he avoid those idle an 'vicious habits which expose him as a rogue or vagabond to the cognizance o 'the criminal magistrate.'

A strong instance of the embarrassing effects of the wretched system of th English poors' laws, particularly as to the right of removal, is stated by Dr Anderson, (in his Essays relating to Agriculture and Rural Affairs, 2d edit. vol. ii. p. 159.), by which it appears that the proprietors in a parish in which an iron manufactory had been erected, had been seized with alarm, as to the eventual oppression of the parish, from the paupers that might fall upon it from among the men collected from all quarters who were employed, if they should be allowed, from sufferance, to acquire right of residence. The proprietors would appear either to have commenced, or to have threatened suits of removal. The owner of the manufacture is stated to have applied by petition to Parliament; but that Parliament found it was not proper for them to interfere in this case. The final result is not stated. No process of such a nature was ever heard of in Scotland, nor could be sustained as competent. In a debate last May, (1811), in the House of Commons, it was stated, that, for the forty years of its existence, the great Carron Ironwork in Stirlingshire, had not brought a single individual upon the parish funds.

* The above statement is applicable to country parishes, where the poor are maintained *in their own houses, exercising, for their own benefit, any little industry of which they are capable.*

The Scots acts of Parliament enjoin the erection of *work-houses* in every parish. But though Scots Parliaments were ever ready to enact whatever was proposed to them by their *Lords of the Articles*, it is as well known, that, when the Barons returned home to their own territories, they resumed their independence, and paid no more observance to their own parliamentary enactments than what suited their own convenience. On this account, and from deficiency of funds, no work-houses ever were erected in country parishes. The enactment was somewhat better observed in towns; but though thirty-two towns, specially designed, are required to have work-houses, very few have accommodated themselves with that conveniency. These work-houses, (in the coupling of really indigent poor and vagrants together in the parliamentary enactments and in reality, it is difficult in practice to draw the line of discrimination), were designed for the confinement of vagabonds, and to compel the able to labour. Where they exist, however, they have been appropriated to the helpless poor and houses of *correction*, under other enactments, have been erected for vagabonds. Common messing, and saving of house rent, would seem to prov ever may be the *form* of Scots poor laws, they are, in *essence*, resolvable, in a great measure, into a *mere voluntary contribution* for the support of the poor, on the part of the heritors and other inhabitants;—as given *voluntarily*, in collections at the church door, or given *voluntarily* by the body of heritors at their meetings. No doubt the deed of the heritors present at the parochial meeting binds their whole body; and when it is constituted, it is the duty of a body of men who meet for a formal purpose, to attend to that purpose when they meet; but, so long as the *quantum* of what they do is left uncontrollably to themselves, it must be their own fault if they suffer themselves to be oppressed. Even under the practical system of the poors' laws, it may still, in a considerable degree, be affirmed, that, in Scotland, *charity is not enforced by law*. And from the example of the ruinous effects of poors' laws in England, any attempt to model the Scots poors' laws into a more compulsatory system, is earnestly to be deprecated.

The poor in Scotland feel themselves, of course, *dependent upon charity;* they thankfully *receive* what is *given;* they make no insolent demand, *as entitled to assert a right:* there is no reliance to lead to improvident marriage, to want of economy, or wasteful debauchery. A Scotsman is ashamed to be indebted for the support of himself or family, to any thing but his own personal resources. * In the course of ministerial duties, I have

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that the poor might be cheaply maintained when collected into one house; but, from Dr Macfarlane's *Inquiries concerning the Poor*, published in 1782, it would appear, that in the Edinburgh Poors' House, which he considers as under the very best possible regulation, the annual average expense of each individual amounted to from 4*l*. 4s. to 4*l*. 10s.; whilst, upon an average, the whole earnings of a tradesman, after deducting house rent, amounted to no more, for food and clothing to himself and family, than 15*l*. *per annum*, allowing only 3*l*. for the maintenance of each, supposing five the number of his family. Such comparative waste may, indeed, be expected from persons living at the expense and risk of other people; such exertions of frugality can be expected only from the strength of natural affection, and the honourable pride of preserving independence. It is stated, that in England, the expense of each pauper in a workhouse is 15*l*. 15s.; a labourer's wages 31*l*. 10s.

It may be further observed, that these formalities of the law are only observed where there are regular parochial assessments. Where no demand is made on the heritors to lay assessments, but the poor are supported by the ordinary funds, the heritors never trouble themselves to interfere with the administration of the minister and session, unless called on to concur as to uplifting or lending out money, &c. Sometimes assessments are laid on by the heritors, in dearths, &c. without allocating pensions, and of course, without determining how long the fund shall last, but leaving the administration entirely to the discretion of the kirk-session and minister, to give regularly, or occasionally, according to need or desert.

* A notable instance of this respectable spirit of independence occurred last winter, (1810–1811.) in the weavers of the town of Hamilton in Clydesdale. Being known to be in great difficulties, through the stagnation of trade, a contribution was made for their relief; but the noble-minded fellows would not accept

often listened with delight, not unmingled with respect, to the honest boast of a labourer, that he had brought up a numerous family in honesty, and the fear of God, without being burdensome to the public, or indebted to any person; and have often come to the knowledge of honourable instances, in humble life, of the most generous self-devotion, inspired by filial affection, for relieving the distress of aged or infirm parents.

It is unquestionable, that where there are no poors' rates, the support of the poor falls entirely upon the liberal; which, indeed, is the best or only reason for having recourse to assessments. It is remarked, however, that where poors' rates have been once imposed, there has been found a necessity for continuing them, and that they have ever been upon the increase; and that in proportion as you increase funds, you create wants.† This has been chiefly experienced in parishes bordering upon England, where English practice has been more readily imitated and adopted. And in the nature of things, it must be expected, that, as you hold out an extrinsic source of independent reliance, you must proportionally weaken the reliance on personal exertion, superseding the necessity of economy and forethought, and opening a door to that prodigality and improvidence, whence poverty, in most instances, is engendered. It seems indeed more than probable, that the abolition of all poors' laws whatsoever might prove a great saving to the liberal, although the whole support of real indigence were entirely devolved upon them, inasmuch as the enforcement of reliance upon independent industry, would beget those habits of provident economy and frugality, which would soon reduce mendicity to such narrow bounds, that the whole existing indigence, to be *then* supported by the liberal, might not nearly equal that proportional part which *now* falls to their share. As in other noxious systems of artificial policy, abolition (gradual, no doubt) would be preferable to the mere palliation of what is radically wrong. *See Malthus.*

One infringement on natural liberty unavoidably leads to some other; and the compulsion of charity, by poors' rates, and consequent circumscription of the liberty of the lower orders, by laws of residence and removal, are intimately connected with statutes of apprenticeship, and exclusive corporation privileges.

If a man has a natural right to any thing, it is to the free employment of his time and talents to his own advantage, in any way that does not interfere with others in their exercise of an equal right. Were every person thus left in possession of his li-

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cept of charity: they of themselves contrived, as a useful public work, in which they might be employed upon day's wages, the construction of a foot-path along the road leading from Hamilton to Bothwell Bridge, and would receive nothing but as the wages they earned at that work. It appears (2d June) that the work is going on, and that contributions continue to be given to it.

† This may, indeed, in a small degree, be accounted for, from the withdrawing of voluntary contribution, when charity is made matter of compulsion.

were then entirely his own concern to find employment ver occupation he should find most profitable, from be- t in demand; but if, by statutes of apprenticeship and on laws, his government shall in effect say to him, *You cise no trade but that one we have prescribed for you, nor in places which we have hedged about with exclusive pri-* t follows, (as a necessary obligation contracted by his ent), that, if his prescribed trade fails him, government harge itself with his support, having precluded him from resource, by its own regulations. And hence the ne- f poors' laws, to remedy an artificial indigence erected bars to the exercise of industry. Agriculture hath, in- ppily never been fenced by corporation privileges; and ations might afford a resource for the trade fallen in o- loyments; but as poors' laws must infallibly lead to the sive laws of residence and removal, this resource is also against the labourer. Happily Scotland has not yet ar- this wretched consummation!

roportion of the poor receiving more or less from poors' the whole population, probably does not exceed that 0 in Scotland; and the expense of their supply may ed 1 *per cent.* of the land rent. To ascertain these pro- accurately, would be interesting and useful, as well as taining of the population, both as to existing number, ther as upheld by the permanence of the individuals, or rapid succession.

SECT. VI.

POPULATION OF SCOTLAND.

Table of Population of Scotland.

	AMOUNT.		
	In 1755.	In 1791.	In 1801.
mount in 1801, may be as not returned,—	1,255,663	1,514,999	1,618,303
n Merchant Ships, -	– –	– –	11,50(
d Militia, - -	– –	– –	30,60(
d Customs, - -	– –	– –	19,60(
rrection of lists obtain- Mr Chalmers, -	– –	– –	20,00(
ing a Total for 1801 of	– –	– –	1,700,00

The fighting men, in the ordinary proportion to the actual return in 1801, Mr Chalmers states at 376,760.

The rate of returned population to one square mile, is at the rate of—

In the 18 northern counties, - - - -	40.17
In the 15 southern ones, - - - - -	92.49
Average of the whole, - - - - -	54.27

The highest rate of population, as might be expected, is in the county containing the capital, and in that abounding most with manufactures, viz.

Shire of Edinburgh, or Mid-Lothian, - -	346.71
Renfrewshire, - - - - - -	331.5
Sutherland county is the least populous, - -	12.55

It is to be regretted that the Legislature has not enacted regulations, by which not only the existing population, at given periods, may be enumerated, but the annual marriages, births, and deaths, be also exactly ascertained. The development of the principles of population by Malthus, has communicated an interest to this class of facts, much deeper than what will ever, now, be taken in the parade of manufactures, or of the Custom-house returns of exports and imports.

SECTION VII.

ON THE VARIOUS MODES OF HOLDING POSSESSION OF PROPERTY IN LAND AS AFFECTING AGRICULTURE.

It is a possible supposition, that all the various entangled, and mutually interfering rights to land, imposed by imperious circumstances, or adopted through ignorance, which have grown into common law, through consuetude, might be disentangled, and rendered unobstructive, by private agreement among the parties concerned. Experience hath shown, that, however possible such agreement may be, it hath rarely been found practicable. It belongs to the Legislature therefore, to enforce such a general disentanglement, by general statute; as also to redress such obstructions as may have ensued from any of its own enactments, either from change of circumstances, or from the original design of the enactment having been found erroneous.

The best constitution of property in land, to excite and encourage agricultural improvements, would infer that sole command and control over it, that excludes all obstruction to management arising from contrariety of counsel and opinion, as also that absolute power of disposal, which would secure to the industrious improver the full possession and enjoyment of the fruits of his industrious application of labour and capital. But both laws of consuetude and of positive enactment have put bars in the way of such a favourable constitution.

In Scotland, as in many other countries, the imperious calls of mutual defence, in times of turbulence and disorder, led to that interweaving of landed property, which might make it, in the strictest sense, a joint and common concern. Small contiguous proprietors would join their dwellings together in little villages; their cultivated land, around their dwellings, would be intermixed in *run-ridge*, that they might incur equal risk; and, for like reason, their cattle and flocks would *pasture in common*, upon the more distant fields. The same contrivance, for the same purposes, would be adopted by the greater proprietors, in allotting their lands among their tenantry. And when the selfish modes of gratification held out in the products of commerce and manufactures, had produced the prodigality of expense which led to that alienation of great estates, which the former more benevolent modes of expense, (in maintaining retainers, in rude hospitality, upon their produce), had not led to, * the parcels successively alienated from these great estates, would naturally be conveyed, under the same mode of holding in which they were occupied by the possessing tenant; and, in this way, the holding of the property in land, in mixed arable and common pasturage, would be more and more extended.

In Scotland, before a general statute was thought of, for division of commons, the inconveniency of common pasturage was felt, and a process of *soum and roum* was made competent to any of those concerned, by which the proportion of the cattle sent by each party to the pasturage, was limited to that number which his proportion of the arable land, to which the right of pasturage belonged, could enable him to fodder in winter.

The division of commons is the subject of the general statute of 1695, which affords an easy and unexpensive mode of process, by which it is competent to any of the proprietors, having interest of property in a common, to compel the rest to a division. And in consequence of this facility given by the Legislature, a sense of common interest has led to the almost universal division of commons into severalty, through Scotland. Those that have merely a right of servitude † upon a common, but no right of property in the land, (which must be determined by the written titles relating to it), are not entitled to force a division; nor can those pursuing competently for a division, force a commutation of these servitudes. The division, however, would not, for want of such concurrence, be defeated: but if the servitude was one of pasturage, some one of the proprietors would get the largest

* Wealth of Nations, Book iii. Chap. 4.

† A proof of forty years uninterrupted possession establishes the right.

share of the land, and be burdened with that servitude; and the same if it was a servitude of peat for fuel, unless, according to the latitude of the act, the mosses were agreed to be left undivided, to be possessed in common, as before. If none have interest in the common, but contiguous proprietors of land, the common is shared out to each, according to the valuation in the cess-books of these lands of his, to which the right in the common was understood to be attached: if others having interest, without having contiguous lands, concur, the division is commonly made according to the actual interest possessed by each.

Lands held in run-ridge, (that is, lands which, though held in severalty, are possessed in alternate minute divisions), are ordained by similar provision of the same act 1695, to be disentangled into distinct continuous masses.

Such a holding of arable lands, is evidently so inconvenient, and so entirely obstructs all improvement, that, one should think, a common sense of interest would easily lead all concerned to adopt a better arrangement by consent; yet, so untractable are the generality in regard to *meum et tuum*, that a compulsatory law, to that effect, had been found necessary. Hutcheson, in his *Justice of Peace*, seems to think, that our Supreme Court has been rather scrupulous as to the extent of power competent for it to assume, in the execution of this clause of the statute.

There are, no doubt, limits beyond which the compulsatory consolidation into distinct single masses of land, held alternately in separate smaller masses, might well be considered as an arbitrary interpretation of the law. Suppose, for instance, there are four fields lying contiguous, each consisting of 40 or 50 acres, the first and third being the property of A, the second and fourth the property of B, it would seem a stretched interpretation, not at all warranted by the indispensable uses of agriculture, to say that A should be able to compel B to surrender his second, and accept of A's third in exchange, in order that each should have an 80 or 100 acre field, in one mass, instead of having, each, two separate fields of 40 or 50 acres each. But, by some decisions, it would appear, that where the fields held alternately consisted of more than four acres in each distinct mass, our Supreme Court have judged the clause relating to separation of run-ridge as inapplicable.

In enacting the statute of 1695, the Legislature was under no embarrassment from the rights of the Church, the subject of tithes having been previously settled by the decreets-arbitral of Charles I. *an.* 1629, as confirmed by act of Parliament in 1633.

Neither does any difficulty occur in practice, from any seignorial right of the lord of the manor. No such right is known in Scotland; the common is considered as entirely belonging to the proprietors of those lands to which the use of the common is found attached; and those who have nothing but an incorporeal right of servitude, constituted by use, though they cannot be deprived of this right of use, by a division, yet they cannot claim any part of the land divided, and may be allocated on the portion of one of the sharers, who is allowed the more, in consideration of the burden.

Enclosure may be of advantage or disadvantage, according to circumstances. And accordingly, the statute makes no provision obliging those who divide commonties to enclose their several allotments. *Permanent enclosure* may be of indispensable use, in countries consisting of hill and dale, to defend the vales under cultivation, from the herds and flocks pasturing at large upon the mountains, or to defend plantations of trees from injury; but in level arable districts, *moveable enclosures of flakes*, serve the purposes of appropriation of fields in crop for feeding, fully as well as the permanent enclosure of hedges and stone walls. And where *these* are not requisite for shelter, or to afford fuel, *those* temporary moveable enclosures are much preferable, in respect of their occupying no space, nor affording harbour to vermin, nor shelter to weeds. Where enclosure, however, is found necessary, the statute of 1661, had previously given, to the proprietor enclosing, a right to compel the conterminous proprietor to bear the one-half of the expense of the march fence, by a simple process before the Sheriff, or county Judge, who likewise is empowered to determine what kind of fence is proper. In some instances, where it glaringly appeared that the march fence was of no kind of use to the conterminous proprietor, our Supreme Court have freed him from bearing his half of the expense. The general presumption of the law is, nevertheless, that enclosure is of equal advantage to the parties on both sides. And if the party exempted were afterwards to take advantage of the march-dike, in forming an enclosure, he would immediately be found liable in that half expense, from which he had formerly obtained exemption; it being evident, from his own deed, that he has no longer a plea for exemption, from his deriving no advantage. *

Straighting of marches is also provided for by statute 1661, as improved by statute 1669. The line of march, at the sight of the Sheriff, is fixed, so as to be most convenient for both parties; and if, for that purpose, it may be found absolutely necessary to cut off land from one side, that cannot be compensated by land from the other side, the difference is compensated in money; which, if the land receiving it is under entail, must be entailed, no difference of this kind making any difference as to the valuation of the land in the cess-books.

Winter herding, as a protection for wood plantations, hedge enclosures, and winter crops, is provided for by statute 1669, which confers right to the injured party to *poind*, or detain the trespass-

* Hutcheson's Justice of Peace.

ing cattle, in security for a fine which he can exact, of half a merk, or sixpence two-thirds for each trespassing animal, without distinction of kinds, as also for the damage that can be instructed.

Such are the wholesome statutes enacted in favour of Scots landed proprietors, in disentangling their property from commonty, for the encouragement of agricultural improvement.

The unlimited power of entail, conferred upon Scots landed proprietors by act 1685, may, probably, have tended as much to discourage such improvements, as the fore-recited statutes to encourage them. † By this pernicious statute, every proprietor of land is empowered, out of his mere caprice, and without authority of any judge, to lock up his lands from commerce, (not only in favour of persons actually existing, whom he can see, and for twenty-one years * farther, but), to all succeeding generations, as far as he can conceive and imagine.

As the entailer is empowered to prevent his lands from being either alienated or burdened with any debt, the possessing heir of entail is merely a liferent usufructuary of the lands. He can give no security upon his lands to his creditors, and can therefore obtain no capital to borrow, to sink in improvements. He has, indeed, no interest to make more permanent improvements, than what would readily repay both interest and capital, during the uncertain tenure of his own life; and his interest in improvement, from that of perpetual proprietor, is thus made to dwindle down to that of mere liferenter. His obvious interest is, to prey upon the land like the locust, taking every thing from it that it will yield, and rendering nothing to it that he can withhold, in order that he may save a provision for younger children; or, it may be, as the *only provision* for any of his children, if, for default of male heirs, the estate passes by the entail to another line. It is not easy to conceive any constitution of the holding of landed property, more completely calculated to damp, or totally to extinguish the spirit of improvement in the proprietor, unless that which is said to take place in Turkey, where the Sultan is the sole heir to the property of his subjects.

To such an absurd height has the will of deceased entailers been allowed to militate against all kinds of improvement, that, by the law, as it was interpreted, entailers could, and even often did prevent their lands from being properly let in lease; ‡ although long leases are evidently the only measures remaining to communicate, in any quarter, an interest in the permanent improvement of estates locked up under entail.

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† Smith's Wealth of Nations, Book III. Part i. Chap. 2. He supposes perhaps one-third of the lands of Scotland to be held under strict entail; and it is extremely probable that the proportion has increased since his time.

* This is the limit of the power of entail in England, according to Paley. *Moral and Political Philosophy*, Book III. Part i. Chap. 20.

‡ Preamble to act 10th, Geo. III.

The immoral effect of entail, in emancipating the future heir, so soon as he is capable of being conscious of the independence of his situation, from all controul of parental authority, is certainly deserving of most serious consideration, although it falls not properly to be treated in a work of this nature. (See *Kames's Sketches*, vol. iv. Appendix.)

The ruinous effects of the statute of entail, in authorising entailers so to fetter their successors, as to deprive them of all interest and inclination, as well as capacity, to improve, had arisen to such an height, during little more than fourscore years of its operation, that, in 1770, a statute (act 10th, Geo. III.) was applied for and obtained, granting some little relief from those absurd shackles which it had imposed.

In regard to improvements suited to the proprietors, (which fall here to be considered), the possessing heir is, by this statute, allowed to lay out money in *permanent* agricultural improvements, (such as planting wood, enclosing, draining, building farm-houses), which are not supposed fully to indemnify a liferenter by their return; * and to constitute himself a creditor against the succeeding heir of entail, for the money so laid out, to the extent of four years free rent of the estate, as the rents shall be at the term of such successor's entering into possession; provided such proprietor charges only against his successor three-fourths of the expenditure he himself has actually made; provided, also, that the successor shall not be obliged to repay, in satisfaction of the claim, above one-third yearly of the free rents he receives; and if he dies before the debt is thus extinguished, the residuary claim extends, in like manner, to the next succeeding heir, who is liable in the resting balance. Provision is also made, to make the possessing heir creditor upon his successor, for building, or repairing, or adding to the mansion-house, to the extent of three-fourths of the money so expended; but that he shall, in like manner, not be creditor, upon this account, to above the extent of two years free rent of the estate, the possessing heir being liable in a third only of what rent he draws. Provision is also made for executing exchanges of land, (which may so often be of advantage to the most profitable occupation of the lands betwixt which these interchanges are made), to the extent of thirty acres of arable, and of one hundred of hill land, unfit for the plough. To this extent exchanges are limited, in transacting with any one conterminous proprietor; but there are ways of creating conterminous proprietors, by fictitious sales, which, though a round-about and expensive way, may, nevertheless, render the latitude of the act tolerably sufficient for all purposes of profitable exchange.

* It is doubted if liming of land, or any plough culture on wastes, is considered as one of those permanent improvements of too distant return to repay the possessing heir.

Confidering the minute attention requifite to all the forms prefcribed in this act, in order to conftitute the charge, and the rather unready mode of obtaining repayment when the charge has been conftituted, with the chances of forfeiture, through the omiffion of any of the forms, the act feems not very encouraging to the improvements that fuit the proprietor. † Accordingly, the framers of this act feem to have confidered, that enclofure at leaft, (probably then confidered as one of the moft important agricultural improvements), was rather to be expected from tenants upon leafe, than from poffeffing heirs of entail. And in confequence, in the latitude given by this ftatute as to the endurance of leafes, the burden of enclofure is devolved upon the tenant, on the well-grounded forethought, that, if not executed at his expenfe, there was but little probability of their being ever executed at all. If the leafe, therefore, fhall extend to the lives of two perfons defigned, or to the fpecific period of thirty-one years, (which feem confidered as equivalent durations), it is provided that the tenant fhall enclofe, in a fufficient and lafting manner, the whole of the lands fo leafed to him, within thirty years; that is, one-third in the firft ten years, two-thirds in twenty years, and the whole within thirty. Leafes of that

† The possessing heir of entail may make the next succeeding heir his debtor, to the extent of four years rent for agricultural improvements, and two years rent for the mansion-house; or in whole for six years' rent. But he himself must have actually laid out equal to one-third of what he charges, as he can only render the next heir debtor for three-fourths of what he has actually expended. Supposing, then, he constitutes a debt against the next heir for six years' rent, he himself, in order so to be entitled, must have expended eight years' rent; but the next heir can only be obliged to give up one-third of what he receives yearly; *i. e.* the creditor can only recover 1-24th part of his capital expended, or exactly 4 1-6th *per cent.*, as the only fund for redemption of his principal. Suppose, for instance, a possessing heir constitutes a debt of 2000*l.* for the mansion-house; as he can charge only three-fourths of what he has expended, he must have expended 2666*l.* 13s. 4d.; let him also constitute a debt of 4000*l.* for land improvement, and he must for this purpose have in like manner expended 5333*l.* 6s. 8d. He dies, and the estate, at the entry of the succeeding heir, is rented at 1000*l.* a year: he has thus, then, legally constituted a debt against the estate to the full amount allowed by the law, viz. Two years' rent for the mansion-house, and six years' rent for land improvement, or in whole a debt of 6000*l.*; but for this purpose, he was obliged actually to expend 8000*l.* The next heir, however, is not obliged to pay more than one-third always of the rents which he draws: he therefore pays one-third of 1000*l.* yearly, or 333*l.* 6s. 8d.; which annual payment is exactly 4 1-6th *per cent.* of the 8000*l.* actually expended.

If the first heir, as debtor, continues to live, he would pay off the debt legally constituted of the 6000*l.* in the space of forty-three years and a fraction, by the surrender annually of the third of the rents as they were at his entry, or paying 333*l.* 6s. 8d. annually, which is all he can be obliged to. And no fresh debt can be contracted, until the first contracted debt shall be extinguished. No doubt, if the first succeeding heir shall die before the expiry of the forty-three years, and the rents should have risen before his death, the debt may be sooner extinguished, as his successor may be compelled to pay one-third of the rent annually as it was at the date of his entry.

The third of the rent received by the possessing heir being the only attachable fund, the recovery must always be the more slow, in direct proportion to the liberality of the outlay.

length of endurance are, however, ſeldom or never accepted of by tenants from entailed eſtates; whether that the term is conſidered as too ſhort to reimburſe the expenſe by its profits; or whether (as a general ſtatute, guarded by ſpecific clauſes, like the bed of Procruſtes, admits not of requiſite adaptation), the encloſure specifically required may not often prove, were it executed, if not poſitively detrimental, at leaſt nugatory and unprofitable. †

Mortmain is a device for giving perpetuity to a continued ſucceſſion of tranſitory intereſts in land. It is accompanied with all the deleterious effects of entail. It is, in ſo far, even a worſe conſtitution of holding, impoſed upon land than entail, that it can have no termination; whereas the proviſion of entail may ceaſe, in the courſe of ages, after all that has been preconceived and provided for has come to an iſſue.

Where the adminiſtration is veſted in thoſe bodies corporate who derive the benefit, we may infallibly expect juſt ſuch meaſures as are calculated to yield moſt immediate profits to the conſtituent members, upon their tranſitory intereſt. Like poſſeſſing heirs of entail, *under many supposable circumstances, they will, uniformly,* find an intereſt in taking from the land every thing that can be ſqueezed from it, withholding every thing of the nature of improvement that does not make an inſtantaneous return.

Where the adminiſtration is in diſintereſted hands, for the behoof of others, the ſame anxiety to make the moſt of a tranſitory intereſt, will not operate: the misfortune only will be, that improvement will not be ſtimulated by the lively ſenſe of perſonal intereſt, but become a merely gratuitous exertion.

There are ſpecimens of mortmain in Scotland under each conſtitution of adminiſtration, but to no great extent.

The glebes of the Clergy, conſiſting of from ſix to eight acres each, and amounting perhaps to from 6000 to 8000 acres of land upon the whole, conſtitute probably the greateſt amount of Scots lands held under mortmain. Though they are placed under the firſt mentioned, and worſt ſpecies of adminiſtration, yet, as the Cler-

† If it is considered as essential that nobility should attach to matter, and not to mind, and that it should be perpetuated by its permanence in lands continued in the possession of individual families, rather than by fresh issues of personal creation from the perennial fountain of honour, such a reason may justify, perhaps, the unalienable attachment of the family estate to the male representative, though at the expense of beggaring all the other members,—lest his poverty should make his nobility become ridiculous; and yet in England, the matter would seem left much more to the discretion of individual prudence, without sensible inconvenience.

But it is surely unbecoming the wisdom of the Legislature, to suffer every individual, from his own whim and caprice, to lock up his land, to perpetuity, from commerce, making it stagnate, for generations, in hands which he has incapacitated for improvement by the fiat of his will. If the lands are considered as constituting the great capital of the nation, it wears absurdity on the face of it, to suppose that any individual should be entitled thus to condemn it to a state of comparative sterility. To withdraw support from entail, would be preferable to any palliative administered to such a rotten constitution.

gy in country pariſhes, who alone have glebes, find it neceſſary (for accommodation of a riding horſe, carriage of fuel, &c.) to retain their glebes in their own perſonal occupation, they are ſtimulated by example, and to avoid loſs of reputation. Within this half century, from their ſuperior intelligence, they were held as models of farming, notwithſtanding of their intereſt being merely that of liferent. Their farming does not *now* make ſuch a *distinguished* figure.

SECT. VIII.

OF HOLDING OF LAND UPON TEMPORARY TENURE.—OF LEASE,—AS ALIENABLE, OR PERSONAL;—UNDER RESTRICTION, OR FREE MANAGEMENT.—BURDENS.

The tenure of lease comes to be a matter of primary importance to agricultural improvement in modern times, when, from the conſuetudinary law of the preference of primogeniture, and the inſtituted policy of entails, (conſtitutions utterly unknown to the Romans), the lands, inſtead of crumbling down, in the partition of ſucceſſion, or in the varieties of alienation, have a tendency to accumulate into, and to be retained in ſuch maſſes as are too large for the perſonal occupation and ſuperintendance of the proprietor; making it, of courſe, more for his intereſt to hire out their uſe, than to manage them himſelf.

Upon the downfall of the Roman empire, it ſeems to have been the univerſal policy of the barbarous invaders, to divide the conquered lands into large eſtates, among the different leaders of the various tribes; and as theſe chieftains yielded a very limited ſubmiſſion to any common ſovereignty, each eſtate conſtituted, in a great meaſure, within itſelf, an independent principality: its ſtrength depended on its largeneſs, and its unity and indiviſibility were enforced by obvious neceſſity, in the ſame manner as *these* have come to be conſidered as fundamental laws of monarchies. The original inhabitants were, very probably, in general, reduced to the ſtate of the Helots among the Lacedemonians. The chieftain would cultivate what part of the domain he retained in his own immediate poſſeſſion, by means of ſuch ſlaves conſuming his produce, in the only way in which he could conſume it, in the abſence of arts and manufactures, by feeding his military retainers in his halls; aſſigning to others of them, upon mere quit-rents, portions of his lands lying at greater diſtances; or, in other words, maintaining in their own houſes, thoſe retainers or ſoldiers which could not be contained within the walls of his caſtle.

The first species of the immediate cultivators of the soil, under the head, *chieftain and his subordinate retainers*, seem to have been slaves. But as a slave, incapable of acquiring property, can have no possible interest but to eat as much, and work as little, as he can, it must soon have obviously appeared for the interest of the master to communicate an interest to the slave in his own labours, by admitting him (like the Roman *Coloni partiarii*) to a share of its products. The proprietor then advanced the stock, and the *villains*, now emancipated and capable of acquiring property, shared the one-half of the produce, (like the *Metayers* of France, or ancient *Steelbow tenants* of Scotland), restoring to the proprietor, at their quitting the lands, or being ejected, the cattle, utensils and seed corns, which they had received from him at entering to them.

Under such a constitution, it might be for the interest of the metayer, or steelbow tenant, to cultivate to such an extent as could be done by the stock advanced by the master; § but it would as evidently be inconsistent with his interest to fix, in land improvements, any part of that stock which had accumulated in his hands from the savings of his copartnery, unless he was assured of the secure possession of the land, for such a length of time as might afford him a reasonable prospect of withdrawing, in its annual returns, the stock he had sunk in improvements, together with its interest, and a proper compensation for risk and trouble. Such views, therefore, would lead to the adopting of a certain period of holding, and of a fixed rent, over and above which, the whole produce should be the tenant's own.

Thus the obvious interest of the parties concerned would come to improve the condition of the actual cultivator, from a state of absolute slavery to that of the steelbow tenant or metayer, and from that to the present state of the farmer, properly so called—*occupying for a time certain, and at a rent certain, and farming entirely upon his own capital, and at his own risk.*

The interest of the sovereign, in the various European monarchies, concurred to accelerate this natural progress, in thus raising up an independent power, with which it might unite, to cope more successfully with the overgrown power of the feudal aristocracy.

Such is the most plausible theoretic history of the lease, according to Dr Adam Smith and Lord Kames.

In England, it would appear, that the great security communicated to the tenant, was not merely the protection of his lease, but the extension of the right of franchise;—a security which is found sufficient, it is said, to supersede altogether the security of the lease. ‡

No such extension of franchise having taken place in Scotland, the security of the Scottish farmer, necessary to excite him to

§ And yet, if a tithe of the gross produce is considered justly as a great discouragement to production, the tax of one-half must be much more so.

‡ The acknowledged superiority of Scots agriculture, would, however, seem to show the preferable security of the lease, unless we are to conclude, that industry becomes vigorous, in proportion to the struggles it has to maintain with those natural disadvantages which it is its province to overcome.

industry and outlay of his capital, must rest entirely upon his lease.

The *Magna Charta* of the Scots tenant's security, is the act of the Scots Parliament 1449, under the reign of James II., which secured the tenant in any length of lease, against any one whatsoever in whose hands the property might come to be vested, whether heirs or purchasers, by either of whom, it would appear, he might formerly have been ejected, his right having been considered rather as a *personal right*, good against the possessing proprietor who had granted the lease, than as a *real right*, establishing a *lien* upon the land itself. The subsequent act 1469, freeing him from being answerable for the debts of his landlord, (with whom he had been before identified), excepting in so far as he himself should be indebted to his landlord in rent by his lease, entirely completed his security.

A short-sighted avarice, defeating its own intention, might still, no doubt, have led illiberal minded proprietors to grasp at the profits of improvement, by such extreme short leases as should deprive the tenant of every rational inducement to make them. These enactments had, however, given complete sanction to every contract of lease, of whatever length of duration might be thought proper, to give the tenant an interest in the most liberal outlay of his capital, and upon improvements of the most permanent duration. The Legislature had done every thing that was proper for the Legislature to do in this respect, for encouraging agricultural improvement. The rest was left to the common sense of interest in the parties.

Unhappily, however, the baleful entail act of 1685, put it in the power of every particular individual, possessed of land, entirely to defeat, as to his own property, the liberal intentions of these beneficent acts, by enabling him to force upon the adoption of all succeeding generations, (which he was capable of preconceiving to exist), his own particular views, however illiberal and unenlightened. And as dogmatic obstinacy and presumption are generally proportioned to the degree of narrow-minded ignorance, there was danger to be apprehended, as the lands might successively fall into the hands of such illiberal minded proprietors, that the whole lands of Scotland might, in process of time, be doomed to a state of sterility and waste. In fact, it would appear, that, in the period of 85 years of the continuance of the operation of this act, so much of the lands had been placed under the most absurd constitution as to the power of leasing, restricting leases to very short periods, or debarring all leases for more than a single year, that this *daily increasing mischief* * called loudly for the interposition of legislative redress; and the palliative statute already mentioned was obtained.

* Epithets applied to it in act 10th, Geo. III.

As the latitude of that statute, of 31 years' lease, is never almost embraced by Scots tenantry, for the reasons already assigned, the only relief as to the power of leasing, is the granting to the possessing heir the power of letting leases (without imposition of any conditions on the tenant) for 14 years and one life, or for 19 years,—held, it would seem, as equivalent durations;—a period by much too short to admit of a proper recompense to the tenant, for any considerable improvement, of expensive outlay and distant return; a description of character applicable to all the most important parts of agricultural improvement.†

The statute, indeed, confirms every latitude already existing in entails; although they should contain, either expressly or by implication, powers of leasing more ample than what are given by this statute itself. But here, too, the genius of the Scots law, at least as of old understood, militates against that length of lease which would be necessary to give the tenant interest in improvements of expense and permanency, by the short endurance of lease, which, in construction, it confounds with that *alienation* which the entail prohibits. If the entail, then, is entirely silent as to length of leases, the question comes to be, What length of lease, in legal construction, is to be held equivalent to alienation? Whether, like our old law writers, (who seem to have known nothing at all, as to what was necessary to excite a spirit of improvement), we shall hold a ten years lease as a *quasi* alienation, or extend the period to 99 years, *when*, according to the accountants, an annuity comes to be of equal value with a perpetuity?‡ Or, whether we shall fix on some intermediate period? Or, if so, by what rule it shall be fixed? Or, if the entail, whilst it debars alienation, shall positively grant a latitude of leasing, to a greater extent than what shall fall under the denomination of *quasi* alienation, (supposing that point to be settled), whether the clause debarring alienation shall be enlarged in its interpretation, to correspond with the given latitude of leasing; or the given latitude of leasing be curtailed within the period which is legally constructed into alienation?

The *jus delectus personæ*, in regard to his tenant, supposed in the eye of Scots law a necessarily inherent right in the landlord, tends, equally as the policy of entail, to damp in the tenant the spirit of liberal improvement, by depriving him of the proper security he should possess, of reaping the fruits of his industry.

Though intended for purposes extremely different, the holding

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† In France, 27 years leases *were* supported by law; though *there*, as climate does so much, there is no such urgent need of stimulating industry by superior length of lease.

‡ These are debateable points; in regard to which, it is to be hoped, a general decision will be given, in the cause at issue between the Earl of Wemyss and the tenants on Nidpath, and executors of the Duke of Queensberry.

of lands in lease for agricultural purposes, has been forced, most incongruously, into the analogy of a land benefice for military service; and the law maxims applicable to the latter, have been preposterously applied to regulate the interpretation of the former. It has fared better, however, with the military benefice, than with the tenure of the cultivator of the soil; for whilst the former, from being held at will, came, through consuetudinary law, to be held for life, then as descendible to heirs, and at last in full property, with complete right of alienation, whether *inter vivos* or *mortis causa*, the legal construction of lease stopt short, in its being made descendible, by succession, to heirs-at-law. Unless, then, when the lease is of length of endurance, exceeding so far the probability of the life of a person of age to enter into a contract of lease, as to preclude the legal supposition that the proprietor preferred the tenant out of a predilection for his person,* the tenant can neither alienate it, nor dispose of it by his latter-will, nor can it be compulsorily alienated from him to satisfy his debts.

Nothing can be conceived more calculated, under many supposable circumstances, to discourage the Scots tenant from sinking capital upon the improvement of lands held in lease, than these absurd constructions of Scots law, which may virtually reduce his interest in his lease to the mere precarious tenure of a liferent; rendering him equally barren, as to improvement, as an heir of entail.

The constitution of the lease is matter of private legislation, as well as of legal construction; and as *pactio tollit legem*, the landed proprietor has it in his power to emancipate the lease from these fetters of feudal barbarism, by expressly renouncing his *jus delectus personæ*, and giving the tenant full power to alienate or dispone his lease; and, considering the obvious expediency of such a measure, it is not a little surprising, that, even at this day, instead of renouncing the legal construction, it should be very commonly still farther confirmed, by express clauses excluding subtenants and assignees, legal or voluntary. The truth seems to be this:—Professional lawyers are generally employed to draw up contracts of lease; and, having their imaginations pre-occupied by feudal ideas, suggested in the course of their Scots law studies, they may have got into the habit of considering the *jus delectus* as an essential appendage of the landlord,—perhaps as re-

* By a very late decision of our Supreme Court, if the lease is only for endurance of 19 years, the proprietor's *jus delectus* is presumed to be retained. By other decisions, an endurance of 31 years makes the presumption, that it is renounced. The intermediate endurances are a debateable ground, for the regulation of future decisions. If the lease of the land is given by public roup, or, as is more common, by secret roup, in taking in sealed offers, *quære*, Whether, according to the analogy of feudal law, this ought not legally to infer renunciation of the *jus delectus*.

flecting upon him somewhat of the glore of ancient feudal baronial dignity ; and both landlord and tenant, may have accustomed themselves to consider such clauses as the mere technical pleonasms of legal verbosity. Whilst tenants, too, possessed little, either of skill, capital, or industry, they might make less account of the power of disposal of a subject, in which they had no view of fixing much of their own ; nor could the landlord's avarice be much tempted to evict a forfeiture, upon the assignation of a lease, where no improvement had been made upon the farm, to yield a profit to him upon re-leasing. The late unprecedented rise of rents seems, however, to have awakened the cupidity of some landholders ; forfeitures of the lease have been pursued, where the *jus delectus* had been violated by assignation; and tenants have been taught, to their cost, no longer to consider such clauses as unmeaning expletive formalities.

The lease being the only security possessed by the Scots tenantry, to encourage their industry, the constitution of it comes to be a matter of the first moment. And as many Scots landed proprietors, and particularly their business men of the law, seem to adhere with obstinacy to a blind prejudice in favour of the retaining of the *jus delectus* on the part of the landholder, it may be proper to illustrate more particularly its discouraging influence upon agricultural industry.

And, *first*, It may be observed, that it is almost entirely destructive of agricultural credit. There seems no reason why a monied capitalist should scruple to lend his money to be launched out in feasible schemes of profitable agricultural improvements, any more than upon manufacturing or mercantile speculations, if only the creditor had equal facility of attaching the lease of the debtor, to be sold to the best bidder, at its improved value, as he has to attach and dispose of the possessions of the manufacturer or merchant. Unless, however, the *jus delectus* is positively renounced, (in a nineteen years' lease, and whatever other periods shall be decerned to lie under its influence, from nineteen to thirty-one years), the creditor cannot attach the lease. A device, indeed, is attributed to the late Advocate Lockhart, (afterwards a Lord of Session), by which the *jus delectus* was evaded, by enabling the creditors to place a factor or manager in the farm : * But such a resource would be just as nugatory, as to establishing agricultural credit, as if the law were to say to monied men, in regard to their security upon their mercantile or manufacturing debtors—*You shall not be allowed to bring to the hammer their ships, their machinery, their warehouses ; but if you choose it, we shall allow you to take possession of these,*

* But by a late solemn decision, after mutual consultation of the two Divisions of our Supreme Court, it was determined that the appointment of a factor was a contravention of the clause debarring assignation.

and to continue their trade till such time as you shall have reimbursed yourself by your own successful management. Such, however, is the short-sightedness of avarice, that Scots leases are sometimes, even at this day, constructed with the absurd condition inserted in them, in reinforcement of the *jus delectus*, that the bankruptcy of the tenant shall infer an irritancy of the lease, and shall cause the land instantly to revert to the possession of the landlord; thus precluding any sort of interference of creditors for their interest, and entirely defeating their claims.

But, *secondly*, Supposing the tenant to have abundance of capital of his own, the retention of the *jus delectus* may, in many very supposable situations, deprive him of every rational inducement to fix his own capital in improvements of the farm, even although the period of duration of the lease should allow him otherwise the fairest prospect of reaping abundantly the fruits of his outlay, even in the most expensive and most permanent improvements.

Though the *jus delectus* prevents voluntary alienation and disposal, and compulsory alienation at the instance of the tenant's creditors, it hath not been carried to that extreme of absurdity as to prevent the lease from descending to the tenant's heirs: It descends, however, to his natural heirs by succession, not to such as he might be inclined to nominate: In other words, it is entailed upon those whom the law has designed the heirs, and he is deprived of all power of choice. But supposing the tenant has no children, and that his legal heirs are such as he regards not, or hates, either with or without reason, is it in human nature to suppose that, with the probable prospect of dying during the currency of a lease, of such length of endurance as to give prospect of repayment for improvements of expense and permanency, he should fix his capital in the soil, to be carried off along with the lease by heirs of this description? Will he not rather retain it as much as possible from outlay on such improvements, that he may keep it under his own command, to be disposed of as he pleases? Or, supposing he has sons, he can make no choice among them; the eldest son is legal heir to the tack. But in a lease of sufficient endurance for any material improvement, the supposition having most probabilities on its side, is, that the oldest leaves the family, not choosing to keep himself disengaged from employment in view of succeeding to his father's lease. He may have become merchant, or manufacturer, or may have settled in a distant farm in England or Ireland. If the father dies, he cannot destine it to any other son, who may have remained with him, to assist him in his labours: The heir, and the heir alone, can take up the lease: He must either occupy personally, or in the unprofitable mode of a manager, acting entirely at another's risk, and having no further personal interest in the management, than merely to avoid forfeiture of his wages, through detectable gross negligence or dishonesty.* But either of these alternatives might prove ruinous; he is obliged, therefore, to relinquish the lease to the landlord, to whom it would indeed revert as a forfeiture, were he to attempt disposing of it to the highest bidder. If he has only daughters, by the Scots law of heritages they would succeed equally as heirs portioners, with small prospect, indeed, of the farm turning to any account, either under counterthwarting management, if they jointly occupy, or under the delegated management of a manager, acting without risk of his own; but as they cannot sell, there is no alternative but to throw up the lease; not to mention, that, according to feudal notions, it may be doubtful whether the marriage of a daughter, without consent of the proprietor, might not infer forfeiture, as placing the lease under the *jus mariti*, and of course being equivalent to an assignation. If the tenant, too, should leave none behind him but helpless infants, of what avail could it be to them to occupy the farm by servants or a manager, whom they are incapable of calling to account? If not allowed to sell the lease to the best bidder, it must be relinquished.

But further: Suppose the tenant wishes to quit his farm, for want of health,—or to betake himself to some other profitable profession,—or to take lands in lease in some distant unimproved district, where, from want of competitors, his superior skill would be amply rewarded, and his example might also prove useful; he cannot, like an unfettered manufacturer or merchant, withdraw his capital, by disposing of his present concern to the best bidder: he must either remain where he is, as an *adscriptus glebæ*, or trust to the necessarily more remiss management of servants, (if, indeed, he is not bound to actual residence by his lease); for he can neither withdraw his capital, by assignation; nor subletting, by *grassum*, (fine at entry), given at once; nor gradually, in shape of over-rent.

Partnerships, too, so convenient in other professions, where different talents may be combined to mutual advantage, are altogether ineligible in a lease thus fettered as to its free disposal.

In this manner, through the legal torturing of the contract of lease into a most unnatural conformity to the original tenure of military benefice, and the prevalent absurdity of enhancing upon, instead of counteracting this legal tendency, in the terms of private bargain, agricultural credit is annihilated, and capital banished from agricultural improvements. Under such circumstances, it is ridiculous to hear landed proprietors complain of the reluctance of tenants to lay out expense upon improvements. Their tenants must be cast in a mould different from what is common to other men, if they employ much industry or capital where there is such insecurity of reaping the fruits of such application,

* See the last note.—Such decisions, to which our Judges are constrained by the feudal genius of Scots law, however repugnant to their own conceptions of equity or utility, would strongly indicate the necessity of an alteration of the law.

and where capital, once launched out, runs such risk of eventual forfeiture.

All schemes of catching at the profits of improvement, in re-leasing, by circumscribing the lease to such short duration, as deprives the tenant of interest in making them, and all schemes of snatching at the capital fixed in the soil, in taking chances of intermediate forfeiture, by retaining the *jus delectus*, are childish in the extreme, and must ultimately prove *felo de se*; like the killing of the hen to get at once at her eggs; or the cutting down of the tree to come at once at its fruit.

The landholder and his tenant may be considered as joined in a copartnery, the landlord being the dormant, and the tenant the acting partner; and it is not to be supposed the copartnery can flourish, but in proportion as both are alike admitted to advantages.

The substitution of enforcement by penalties, to a sense of interest, is similar to the substitution of the labour of slaves extorted by the lash, to the labour of freemen paid in proportion to the work they perform. It suits, however, the indolence, the ignorance, and domineering spirit, in which too many would wish to indulge, to attempt to compel by force, rather than condescend to persuade.

The law might be altered to much advantage, and without the smallest inconvenience. Much is within the private power of landholders themselves. And nothing bids fairer to make common sense prevail upon any subject, than a liberal and fair discussion.

A law declaring every lease the full and complete property of the tenant, alienable and disponable at his pleasure, would be of the greatest importance to encourage liberal minded capitalists to betake themselves to farming, would establish credit, and make it practicable to borrow money on the security of the lease. Whilst the dependent, and of course degraded state, in which the tenantry are too often kept, makes men of spirit disdain so servile an occupation. *

Your *reasoners from practical experience*, as they design themselves, will allege, that, as agricultural industry is seen to thrive in Scotland, such allegations of existing causes of its depression are merely theoretical and illusory. To such the only reply is, an appeal to the *internal consciousness* of every one capable of thought and reflection. †

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* If a landholder, or rather his man of business, is aware of the chances of eventual forfeiture in constructing the lease, and at same time is convinced, (as he generally may be), that the tenant has not had the same foresight one would certainly be disposed to condemn such a bargain as fraudulent. A declaratory law, as above, rendering every lease full property, unless where the contrary were expressly declared, would prevent all such fraud. If the tenant accepts a lease with clauses of forfeiture expressly declared, he has himself alone to blame.

† See Appendix I. Note.

Indeed, considering the small chance of raising a fortune in this profession, in comparison of what we see every day realized by merchants and manufacturers, habit, or the pleasures of a country life, can alone account for agriculture retaining much capital in its employment.

Prescribed rules of management, depriving the tenant of all liberty of action, treating him as a mere machine, unentitled to think, and condemning him to one undeviating round, like a blind horse in a bark-mill, have the same degrading effect, banishing from the profession every man of high spirit and enterprise, to those mercantile or manufacturing employments, where he is at liberty to display the energies of his own mind, and to act as a man.

The most that can be said for prescribed rules of management, is, that they may prevent the best known system at the time from degenerating. But they have just an equal tendency to prevent all farther improvement. In early times, when the condition of the tenantry was in a state of greater degradation than at present, it was not to be expected that much information should prevail in that class, or that material improvement should arise from that quarter. *Now*, however, from the greater liberality which has prevailed in the terms of private bargain, with the tendency long shown to a liberal construction of law in favour of the tenant's security, the Scots tenantry have been advanced to a higher rank in the scale of society; and, in an age of such extended intercourse and communication, there is no deficiency of information in this class, nor that bigotry to established practice, which is the offspring of ignorance; so that in many improved districts, the tenantry may be considered as much more fit to direct the proprietors, than to be directed by them. In short, for a considerable time bypast, there seems to have been no prevalent deficiency among Scots tenantry, either of skill to contrive, or of capital to execute: in so much, that where farms become vacant in districts where improvement is less understood, the rents offered by tenants from more improved districts, upon the credit of superior returns from a better system, must either dislodge the present occupiers, or force them to adopt that better system, without which they could not afford equal rent. For though the liberality of the proprietor might lead him to give a certain degree of preference to the present possessors, there are certainly limits, beyond which their expectations of a sacrifice of pecuniary interest on his part in their favour, would be unreasonable. There is thus a natural security for the spread of every real agricultural improvement, if not prevented by absurd regulations of management; a more productive system understood, will lead to offers of higher rent; and higher rent given, must enforce the adoption of the better system.

Through the currency of the lease, the interest of both proprietor and tenant must evidently concur in the same measure, of rendering the land as productive as possible. There is a period, nevertheless, towards the close of the lease, in which these interests begin to diverge; and therefore, restrictions as to the last three or four years, may be necessary to keep the tenant to the mode of management, which his own interest would effectually bind him to during the currency. During these years, a management may be properly enforced by penalties, corresponding to the system understood as the best for that species of farm at the commencement of the lease. But as it were absurd to suppose that any system is perfect, and incapable of improvement, in order that the farm may not be debarred from such improvement as may be found out during the currency of the lease, it should be in the power of the tenant to manage and to leave the farm in any way he pleases, without incurring the penalty, provided he can make it appear, to impartial arbiters, that the farm, in the condition in which he leaves it, is in no worse state than it would have been had the management prescribed in the restricted years been observed.

To avoid this unimproving period, when the tenant may conceive it for his advantage to draw as much from the land as it can yield, rendering nothing to it that he can withhold, it might be of use (at least on supposition of the possessing tenant being preferred) to renew the lease three or four years before the expiration of the existing one; the entry to the second to commence at the expiration of the first. As, however, a lease, to be effectual, must, in consistency with the maxims of Scots law, be *clothed with possession*, it is uncertain if, without an express alteration of the law, such a lease would be good against a succeeding heir of entail; or even a purchaser, if either come to be vested in the property before the expiration of the current lease. †

The late Lord Kames, whose original, comprehensive, and versatile genius, was well calculated to throw light upon every question which he made the subject of his investigation, and who was probably the first agricultural writer who paid much attention to the *moral excitements* of agricultural industry, was well aware of the futility of the substitution of enforcement, under penalty, to the tenant's sense of his own interest. To impart, therefore, to the tenant a continual and unceasing interest in the improvement of his farm, he fell upon the contrivance of the perpetual lease, by which the tenant was either sure of a preference at re-leasing,

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† As it would be highly inconvenient that leases of this kind should be absolutely invalid, our Courts have decided that such a lease is valid, if granted in *the ordinary course of administration*. The length of term seems not, however, fixed. The framers of act 10th, Geo. III, seem to point at one year previous to the expiration of the current lease, which is by much too short a period to prevent the want of interest in improvement.

or else of a certain number of years' purchase of the advanced rent offered by himself. Here, however, as elsewhere, the absurd policy of entail would prevent the adoption of such a scheme of improvement, as no obligation to this effect, granted by a possessing heir, would, in any probability, be held valid against the challenge of the succeeding heir. The only objection against such a constitution of lease seems to be, that the farm must continue for ever of the same construction as to size, &c. however inconveniently arranged in such respects, without consent of both parties; though mutual consent to alteration, if obviously fitting the farm for more profitable occupation, might not be of very difficult attainment.

Restrictions as to management ought ever, at all events, to be clearly and explicitly expressed, otherwise the tenant must be kept in a most discouraging state of perpetual uncertainty. The reporter of East Lothian observes, that the vague obligatory clauses, binding the tenant in general *to practise the rules of good husbandry, and not to mislabour the farm*, have, in that quarter given rise to many most unprofitable lawsuits. The various acts of Parliament, freeing the tenant from every prestation, unless what he has expressly stipulated to perform in his lease, might seemingly have rendered all such unspecific clauses of obligation unactionable before a court of law. It would appear, however, that they are held actionable. And this being the case, many questions of course may arise as grounds of litiscontestation: As, *first*, What is to be understood as rules of good husbandry? Is it to be understood, according to what may be reasonably supposed to have been conceived to be good husbandry by the parties at the time of entering into the contract, or as what may come to be considered as good husbandry during the currency of the lease? If the latter ambulatory interpretation shall be fixed upon, may not the tenant, at any time, be interrupted by the landlord in his proceedings, till it shall be determined whether what he proposes to do is good or bad husbandry? which, probably, may not be decided till the season for performance has elapsed.* As it is probable, few landholders would thus choose to intermeddle in teazing the tenant in every step of his proceedings through the whole of his lease, it is probable that the question of what constitutes good or bad husbandry, might not be agitated till towards its close. And here, supposing the point as to the constitution of good or bad husbandry to be indisputable, still a *second* question might arise, Whether the point of good or bad husbandry had

* So different are the prevailing ideas of good husbandry, that Scots tenants, who took in lease farms in England, at high rents, in view of rendering them more productive by alternate husbandry, were interrupted in breaking up old grass lands, by eventual heirs of entail, upon the footing that this was committing waste upon the estate. *See Farmer's Magazine.*

been settled in the general opinion, in such a time as that the tenant should, in equity, be considered as bound by his obligation to have adopted the improved practice? For a practice in husbandry is not, in reason, to be held as an improvement, merely because it is an innovation; good sense requiring, in this as in other subjects, a renitency against hasty change; and as there is, of necessity, a certain loss always to be sustained in the disarrangement of one system, in preparation for the introduction of another, it may be, that the tenant's lease was too near to its expiration (by the time that he might be supposed apprised of the better system), to allow of reaping, from the practice of that system, any adequate compensation for the loss to be sustained in the preparation for its introduction. At any rate, as all questions of this nature must ultimately be remitted by law courts to arbiters, wherever such a vague clause of obligation is admitted, it ought to be accompanied with another, binding both parties to submit any dispute that might arise upon it, at once to arbiters mutually chosen.

The security of lease has been every where through Scotland the *primum mobile* of superior improvement.* The total want of that security is almost nowhere complained of, excepting in the Highlands of Scotland; and where the proprietors, out of mere humanity, and at the expense of great sacrifices of their own pecuniary interest, are still continuing upon their lands, (till they can dispose of themselves otherwise) that disproportionate population for which there can be no profitable use, upon the introduction of a more profitable system of occupancy, it is not to be expected that they should entail upon themselves such an unproductive system, or give it permanency through the security of lease. †

Size of farms is of considerable consequence to their profitable occupation.

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* Leases, and long leases, have been considered equally as the great causes of improvement in England. *Caledonia*, vol. ii. article Peebles-shire.

† See Lord Selkirk on Emigration from the Highlands.

His Lordship's antagonists display more of partial humanity, than of enlarged views of public utility. In their zeal for supporting Highland population, some would even persuade us, that, in respect of talents for military service, a Highlander is of a *sui generis* description, constituting a breed of a superior kind. It is however pretty evident, that the human character is formed from circumstances, and those talents drawn forth for which there is occasion. The national reciprocated hostile incursions upon the Borders, gave a more constant occasion for hardy intrepidity and alertness, than the mutual predatory warfare of the Highland chieftains; and accordingly, the Borderers were in use to be called out to quell insurrections in the Highlands. Such specialties of character disappear upon change of circumstances. Highland regiments are now indiscriminately recruited from the common mass, and all equally acquit themselves well. A British soldier will ever act as a hero, whether Highlander or Lowlander.

The principles that appear to regulate the size of farms, seem to be the following.

Capital will ever endeavour to invest itself in the manner in which it can yield the greatest return. Now, a considerable extent of farm (such as to admit, as much as possible, of subdivision of labour, in appropriating particular classes of servants, or even of horses, exclusively to one occupation), seems necessary here, as elsewhere, to make labour most productive. In farming, too, (at least in a climate such as that of Scotland), advantage must often be taken of states of the weather, suited to particular operations, lest the opportunity should escape: such calls require a number of hands, and these would be kept in an expensive and most unprofitable state of preparation, were not the farm of such magnitude as to afford room for separate occupation to the whole at all other seasons.

The competition of capital for the most profitable mode of investiture, will thus tend to the enlargement of farms to the size of most profitable occupancy.

The same competition of capital will also tend equally to prevent farms from stretching beyond these proper bounds, and thus to prevent monopoly. For though one man may excel another in point of intellect and exertion, the difference is very limited: the generality are upon the equal footing of mediocrity. There is an extent of farm, to the *personal management* and superintendence of which no man's energy can reach, but where he must of necessity have recourse to the uninterested, and therefore unenergetic, *management of delegation*. But an interested and sharp-sighted personal superintendance will ever be able to outbid, in affordable rent, the more languid and inefficient management of delegation Indeed, it is upon no other footing that farmers exist as a class distinct from proprietors, but that the proprietor finds he can obtain more as rent than his lands will afford him of profit, although he pays no rent, under a management delegated to overseers; as has been already noticed in tracing the origin of lease-holding.

Where there is sufficiency of capital to occupy and employ the whole lands most productively, the competition of capital will thus both enlarge farms to the proper extent, and circumscribe them within the proper bounds for yielding the largest production in proportion to the labour employed: and such excess of agricultural production, above the consumpt of the labourers employed in raising it, is the only fund which can support the great numbers employed in commerce and manufactures, without raising up a population of this description dependent upon the agriculture of other nations for subsistence;—not to mention the numbers of unproductive classes in the army, navy, cabinet, priesthood and forum, and those disengaged from any professional employment, who can receive subsistence from no other source but this excess, as they produce nothing of value in exchange among other nations, for which they might receive the surplus produce of foreign agriculture in return.

A sort of country trading capital will also have some little influence upon the size of farms. As labour comes to be more and more subdivided, in pursuance of the common sense of individual interest, the farmer will more and more exclusively confine himself to his proper business of a producer; merchants will transact betwixt him and the consumer; professional carters and carriers will also spring up; and these will, to a certain extent, raise such an effectual demand for minute farms, for conveniency of keep of draught horses, as no occupation for the general purposes of agriculture can compete with.

Had public legislation never interfered in cramping the free use of perpetual landed property, by the wretched policy of entail,—and had private legislation not withdrawn (through pride or avarice) all right of property from the occupation of lease, in debarring assignation and subset,—the most profitable occupancy would ever take place, upon the strong-telling principle of its being able to afford most.

No agrarian project, devised by those idlers who devote themselves to speculate for the public good, but which nobody is interested to effect, can ever possibly be realized. This observation may probably be found applicable to all those schemes of land-occupancy which have been humanely devised for the Highlands of Scotland, in order to retain that extent of population which can only suit a situation of landed property such as that described in entering upon this article of *the holding of land upon lease.*

The legal protection of vermin, may well be considered as injurious to the agricultural industry of lease-holders.

As in the vegetable world, we account those plants which take nourishment from the soil, but which cannot be converted into human use, to be *noxious weeds*, in contradistinction to the crops; so in the animal world, we account those animals which consume the vegetable or animal produce of agriculture, but which are either unfit for human use, or cannot be brought under the command of man, to be *destructive vermin*, in contradistinction to farm live-stock.

All game animals come under this description, as also pigeons, which, though in a state of semi-domestication, are nevertheless of a *semi-feræ naturæ*: Against their licensed depredations, the agriculturist, holding lands upon lease, enjoys no power of prevention, and he has little recourse for compensation. The game laws, obtained in favour of the monopoly of those vested with the exclusive privilege of appropriating them when they can catch them, are of similar complexion with those mentioned in a preceding long note, Sect. II. p. 208 *& seq.* as obtained by the manufacturing and trading part of the community, in favour of their respective monopolies.

The immediate damage occasioned by the licensed depredations of these protected vermin is, however, but of small account. 'The only damage at all worth attending to,' (in the words of the Agricultural Survey of Peeblesshire, p. 246.), 'is that resulting from men, and dogs and horses, in pursuit of the game.

'In regard to the detriment of agriculture, the very worst possible regulation, in respect of the game, would be to throw it indiscriminately open, with liberty to pursue it everywhere, to all without distinction. The very best would be, to vest in the occupying farmer an absolute power of preventing every person, without exception, from hunting over his farm against his consent. A privilege thus granted of favour, and not held of right, would never be abused, to the damage of farming stock.

'No doubt, those privileged to hunt, are commonly in circumstances to enable them to make full compensation for any damages they may occasion, and in such situations of respectability, as would restrain them from knowingly occasioning any damage whatsoever; yet, without some such regulation, property launched out in farming can hardly be conceived equally protected by law as other property launched out in the business of other gainful professions. To have recourse for damages, merely where damage can be legally instructed, would nowhere else be considered as a sufficient compensation for having property put in risk at the mere pleasure of another.

'Suppose the whimsical privilege were assumed, of playing cudgel matches, for diversion, in a glass or china shop: The shopman would surely have some reason to be dissatisfied with this privilege, although he had the most undoubted security of recovering all damages that might ensue, and though, from the nature of his wares, no damage could possibly occur, in total fracture, or even mere fissure, but what could with ease and certainty be instructed. In hunting, however, for example with slow-hounds in Tweeddale, where the sheep, walking wide, are naturally very wild, the mere recourse for legally instructed damage, must afford still less adequate compensation for the risk, as, from the nature of the property, much damage may be sustained, which is utterly incapable of any legal instruction; such as, loss or prevention of fat, from disturbance in their pastures,—diseases consequent upon over-heating, in running through fear, or even upon fear itself. Here, as elsewhere, the power of prevention of unnecessary risk is the proper and best security. Upon the other hand, it would appear a severe regulation to exclude the proprietor, without leave asked and granted, from such rural sports as he might find upon his own grounds, which might have a tendency to prevent monied men from investing their capital in the purchase, the improvement, 'and adorning of landed estates. Expediencies here clash, and 'the subject is confessedly of great delicacy. Farmers, no doubt, 'are apprized of their situation, and, in their calculations of dis-'count must make allowance for risks, whether more constant 'or occasional. Meanwhile, I have stated the matter in the 'strongest point of view, as there can be no harm in reminding 'hunters of the very particular situation in which the very va-'luable farming stock of the country is placed,—a circumstance 'perhaps too apt to be forgotten in the ardour of the chase.

'Game seems now, by the latest decisions, to be considered 'as property, or at least, that the property of another cannot be 'rendered subservient to the use of starting game in it, or of 'following game through it; and it is thus happily in the power 'of the proprietor of the lands to exclude all privileged hunters, 'whose rashness might render them more regardless of risk upon 'the property of another, where they have less interest in the 'tenant's thriving.'

Burdens affecting the leaseholder deserve consideration, in regard to their effect upon agricultural industry.

Taxation, laid equally and proportionally upon *real income*, is undoubtedly the fairest of all, and, if fairly and impartially levied, could discourage no kind of industry in particular, as no person would refrain from bettering his own circumstances, that he might thereby impoverish the public treasury. But the present system of taxing the *imputed*, as the *real* income of Scots leaseholders, must be extremely unequal. At next period of leasing, no doubt, offerers will be in a state to consider the tax paid upon rent, as, in effect, an addition to the rent; their offers will be proportionably less, and the tax will turn out merely a tax of 15 *per cent.* upon land.

Taxes upon gross produce of land are of the very worst constitution of taxes, because they cannot be proportioned to profit or real income, as the worst land requires always equal, often greater, expense of culture than the best, whilst the return must after all prove greatly inferior.

Tythe of produce is, in this view, as well as in various other respects, an ill constituted tax, more expensive to the payers than profitable to the receivers; highly discouraging to agricultural industry, and more particularly to the cultivation of lands of inferior quality. From this tax, at least in shape of a tax upon gross produce, the lands of Scotland are entirely exempted. Ever since the decree-arbitral of Charles I. in 1629, as confirmed by act of Parliament in 1633, it hath been in the power of every Scots proprietor of land to have had the tythe of his lands valued and fixed for ever, at one-fifth part of the actual free rent at the time of valuation, and also to purchase his tythe from the lay impropriator, or *titular of the teinds*, (the tythe having never, in any part, been in the possession of the Reformed Clergy), at (according to certain circumstances) six years or nine years purchase of them as so valued. These teinds, so purchased, continuing liable, after those not purchased should be exhausted, to such stipend as the Scots Parliament (since the Union the Court of Session) should judge it meet to allocate from them to the Clergy.

Tythe may be commuted upon two different principles; either that of fixing them down for ever, as in Scotland, at their presently existing value; or that of allowing their value, like that of rent to keep pace with the increasing value of land. If valued upon the first principle, the commutation must either be,—in money, which exposes them to fall with the depreciation of money,—or in equivalent of allocated land, which dooms it to sterility under mortmain holding,—or in a grain rent, which would not be attended with the inconveniencies of disputes about quality, or of forcing the Clergy into the corn trade, if the *ipsa corpora* were neither tenderable nor exigible, but to be paid for always at a conversion money price, and upon the average of last seven or eight years (to prevent the effect of the wide fluctuations of grain prices from year to year). If they are commuted upon the second principle, of their value not being fixed, but left ambulatory, to follow the fluctuation of the value of land, none of the above modes of commutation can apply, but the deleterious one of the allocation of land. And no other eligible mode suggests itself, to avoid the present bad constitution of a tax upon gross produce, but converting the tythe into a given proportion of the free rent paid to the landholder.

By act 1748, the Scots tenant is relieved from all burdens not expressly stipulated in his lease, or what should be imposed by act of Parliament, excepting the one half of schoolmaster's salary and of poor's rates, and adstriction to mills.

The tenant's half of school salary and poors' rates will hardly, on an average, exceed one or one and an half *per cent.* upon his rent.

Adstriction to mills, so far as it goes, is, like tythe, a tax upon gross produce, and gives the same obstruction to land improvement.

The rate of adstriction, both as to the quantity of produce over which it extends, and the proportional part of that quantity which it claims, is various, in various parts of the country. The lowest quantity of adstriction extends to all the oatmeal used in the family of the farmer,—a quantity not susceptible of very accurate definition. That quantity the privileged mill has the exclusive privilege of manufacturing, and is entitled to a twenty-fifth part, (the lowest proportion generally accompanying the most confined extent), as *multure*, or price of the manufacturing, instead of a thirty-second part, which is esteemed the ordinary market rate. The exclusive privilege is sometimes found to extend to all the growing corns, seed and horse corn only excepted;

and under such extension, the proportion exigible as multure, reaches sometimes to the tenth part.

The adstriction is, very generally, understood to extend only to oats, peas or barley, being probably little known at the time of the constitution of the adstriction. And in these cases, the farmer may be tempted to substitute some of these grains where oats would have been the preferable crop. Land in pasture is universally understood to be liable in nothing to the privileged mill; and where the rate of adstriction is extensive and high, it may lead to a disproportionate allocation into pasture.

The exclusive privilege of employment is ever felt galling to those subjected to the yoke; they can never feel confidence in being well served, by those over whom they have not the check of being able to withdraw their employment, when they are dissatisfied with the work.

Adstriction to mills, in England, would appear, from Marshall's writings, to have generally died its natural death, by mutual convention or dereliction. In Scotland it is in progress towards decay. Few country gentlemen, above the rate of a Squire Western in point of intellect, ever now think of confining their own tenants to their own mills, under such a preposterous bondage. Where a proprietor of a mill holds the lands of another proprietor adstricted to his mill, it is not to be supposed he should quit his privilege without a compensation. But this might be settled by private bargain, were it not for the obstruction of entail, which here, as elsewhere, is continually interrupting the rational exercise of the right of property in land. A compulsatory provision for enforcing the commutation of thirlage or adstriction, has been obtained by the late act, 39th Geo. III. The terms of it are abundantly equitable. It is made competent for the proprietor, either of the dominant mill or servient lands, to pursue for a commutation, before the Sheriff of that county within which the mill lies; and the Sheriff is to summon a jury of at least twenty-one, consisting of heritors, or tenants of land paying 30*l.* of yearly rent, or valued at 30*l.* Scots in the cess-books; which number, by alternate rejection by the parties, being reduced to nine, they, after examining evidence, are to award an equivalent compensation in a yearly payment of grain, it being in the option of the payer to pay in grain or the price of the fiars; yet there are not many instances of the privileges of the act being claimed, probably from the parties being at a loss to conceive upon what principles a jury would decide, in a case to which it is hard to say what principles can apply.

In grain counties, thirlage is falling into desuetude, through dereliction. The miller becomes an extensive manufacturer of grain; and, rather than have his own plans broken in upon, and his time taken up, by serving those adstricted to him, when they choose to call for his services, he is willing to renounce his exclusive right to be employed, and the higher rate of pay which he is privileged to exact. The farmers confine themselves to production, and the miller becomes their merchant, or their merchant's manufacturer.

Considering the scarcity of capital when corn-mills began to be erected, the over proportion of them to the work to be executed (necessary from the unpermeable state of roads, in order that the work might be executed at all), with the peculiar favour the Legislature seems ever to have been inclined to show to every species of manufacture, whether more necessary or more superfluous; it will not be matter of surprise that erectors of mills should have required, as the conditions of their erection, both a certainty and considerable extent of employment, and at a high rate of wages,—nor that the Legislature should have anxiously sanctioned all those privileges,—nor that the judges should have been ready to bestow upon them a liberal interpretation.

From the ready access to all parts of the country, at all distances, by roads, there is now no need of supporting more machinery than what can find constant and full employment: from the present improved state of machinery, every machine, too, is now capable of performing much more work than formerly. From these causes, although there is now surely much more grain to be manufactured, there is a superfluity of corn-mills, which could not be supported but by the compulsatory employment obtained through adstriction.

The multiplicity of corn-mills going by water (the only moving power known at the time of erection), is complained of as a nuisance in other respects. They interrupt the profitable use of water, for the purposes of irrigation; they often prevent the draining of lands, by preventing the descent of waters; they convert low lands into marshes, from the leakage of mill-ponds and mill-leads. As the whole of corn-mill machinery might be moved by the powers of steam or of wind equally well, and often equally cheap as by water, and as there is no dread of not having machinery erected voluntarily, wherever there is a real demand for its employment; it might not be improper that a legislative compulsator should be interposed, enforcing the sale of the privilege of having a water-mill, at a fair valuation, whereever it could be properly instructed, before a proper court, by those having interest in, and applying for the purchase, that the benefit to result from undamming of the waters, or converting them to the purposes of irrigation, exceeded the rent of the mill by one half or one whole, or some such other over proportion.

CHAP. XVI. APP. No. 2.

ACCOUNT OF THE SECONDARY OR LESS IMPORTANT MANUFACTURES OF SCOTLAND.

By MR JAMES BOAZ of Glasgow.

1. SILK.

ABOUT forty years ago, the Silk manufacture was carried to considerable extent in Scotland. Between the years 1760 and 1770, several London companies established themselves at Paisley, and, in conjunction with the Scottish manufacturers, employed about 5000 looms, which annually produced about 350,000*l.* worth of goods. The introduction of muslins, however, ruined this branch; and, with the exception of the looms weaving imitation shawls and cloth for Bandana handkerchiefs, there are not now 20 silk looms at work in Scotland.

1. *Yarn and Threads.*—There are no silk throw-mills in Scotland. The yarn used for the silk trade is brought from England—also all the sewing silk. The refuse and chippings of the manufactories, after being carded, are spun on the common wheel, or hand jeanie; and the yarn being laid two or three ply, is slightly twisted. This is denominated *Spun silk*, and is used for coarse stockings, which are knitted in the usual manner. This manufacture is still carried on to a small extent in Aberdeen, &c.

2. *Cloth.*—The chief fabrics are imitation shawls. Of these there are four manufactories in Edinburgh, which make these articles from 2*l.* to 9*l.* each in price, of the most beautiful and fanciful patterns; and the annual value of their goods will amount to from 25,000*l.* to 30,000*l.* sterling. The whole of the amount of the value of this branch of manufacture may be about 50,000*l.* yearly. Dark-grounded ginghams, pullicates, with tartan and other gown-pieces, still continue to be made of silk mixed with cotton; but the quantity of these articles is inconsiderable, as the discovery of the method of fixing colours on cotton has now much superseded the use of silk. Ribbons are not made in Scotland, but brought from England.

The silk manufacture is not at present of much importance to Scotland; and the attention of the people is more profitably directed to the woollen, linen, and cotton manufactures, the united value of which is nearly nine millions sterling per annum.

2. CALICO-PRINTING, DYING, and BLEACHING.

1. *Calico-Printing.*

1. *Calico-Printing, extent of, in Scotland.*—The art of calico-printing is carried to great extent in Scotland, particularly in

the counties of Dunbarton, Stirling, Renfrew, Lanark, Perth, and Aberdeen. In the first county, previously to the late improvements in bleaching, the print-fields occupied about 200 acres of ground principally on the banks of the river Leven, and at present they give employment to about 1700 persons.

This business is divided into the following branches—1. Copperplate-printing; 2. Block-printing; 3. Surface machine-work; 4. Pencilling; and, 5. Dying.

1. Copperplate-printing is performed in two ways; 1*st*, The pattern is engraved on a flat piece of copper, and is imprinted on the cloth by a rolling press, similar to those used for common engravings, although of larger dimensions. 2*dly*, The pattern is engraved on a copper cylinder, instead of a flat plate, hence the motion becomes incessant like that of a calender; and the one side of the cylinder receives the colour, while the other is transferring it to the cloth.

2. Block-printing is effected by a piece of wood with a particular pattern represented in relief on its surface. This block is charged with the colour, and impressed by the hand; but if the pattern be heavy, the block is struck with a mallet. In this mode of printing, patterns having different colours require a block for each.

3. The Surface-machine is the latest invention, and was first used in England only about four years since. It has been brought to great perfection, and many of them are employed by the Scottish printers. It consists of a cylinder on which the patterns are cut in relief, and, in fact, is nothing more than a revolving cylindrical block. Both this machine and the cylindrical copperplate-press are valuable improvements in the art of printing. A power less than that of one horse is sufficient to print 100 pieces of 28 yards each per day, while an expert tradesman, by block-printing, can execute no more than five or six pieces.

4. Pencilling is performed by females, with a small brush of camels' hair, or bruised cane, with which the colour is transferred in a liquid state to particular places of the cloth as required.

5. Dying is performed in the usual manner, with this difference, that the colours are attached to those parts of the cloth only which has been charged with a *mordant*, or base, and leave the rest, or such parts as are defended by pastework, unaffected.

Printed cottons are subjected to a duty of about 15 per cent. of their value, or 3½d. the square yard; but as half the whole quantity manufactured is exported, the duty on that extent is returned by Government. Although a considerable quantity of linens are also printed, chiefly for handkerchiefs, yet the great proportion is cotton, and consists principally of furniture and garment pieces, shawls and handkerchiefs.

The amount of the duty collected in Scotland on printed goods for the year ending the 5th January 1813, was 201,004*l.* 3s. 3½d.

2. *Dying.*

This art is yet imperfectly understood; but the progress of chemical science will doubtless lead to its improvement. Wool and silk are more easily dyed than the vegetable substances flax and cotton; but the colours of the former are both more brilliant and permanent than those of the latter.

Fast and Fancy Dyes.—The dyes or tints given to goods are partly fast and permanent, or such as can resist the action of air, soap and water; and partly fugitive, or such as yield to the action of these substances. The blue dyes from indigo, the buff from iron, and the green from these united, are fast colours; but those from the tincture of woods and other vegetables are generally fugitive, especially on cotton and linen.

Turkey-red, &c.—The beautiful and permanent colour termed Turkey, or Adrianople red, is the most expensive and difficult to be given of all the cotton dyes. It was introduced by M. Papillon, a Frenchman; and an extensive dye-work was erected on the banks of the Clyde by the late Mr Dale. * The secret, however, having been discovered, 10 large works were erected in the neighbourhood of Glasgow which employ from 3 to 400 persons. Besides these permanent colours, fancy dyes are given to cotton cloths and yarns as well as to linens, and the blue-dying of linen yarn for checks, stripes, threads, &c. is an extensive branch of the art.

Discharging colours.—There is a peculiar method of discharging colours, connected with the dying business, which it may not be improper to notice here. Bandana handkerchiefs, which are generally of one uniform colour, are folded in squares of the size intended, and being placed in a press between two metal plates, with parallel orifices, the bleaching liquor (oxymuriatic acid) is poured into the perforations, and the colour is discharged. The handkerchiefs are thus spotted, as the parts not exposed to the action of the acid retain their original colour. There are from 42 to 50 presses in Scotland for this work, situated in the neighbourhood of Glasgow, each press generally requires two men who can finish 60 dozen of handkerchiefs per day. At Paisley, there are some Bandanas made of silk, but the spots are produced by tying with a thread each distinct place in the handkerchief intended to be kept white; the cloth is then dyed, the parts tied up receiving none of the colouring matter. This is the eastern method of spotting silk and cotton handkerchiefs.

3. *Bleaching.*

This art consists in clearing yarn or cloth from its impurities,

* It was in consequence of a handsome premium given by the Board of Trustees in Scotland, that M. Papillon discovered his important secret; a proof, among many others, of the utility of that institution.

which occasion the dark or dusky colour of flax, and the dun yellow colour of cotton. Bleaching was formerly, and still is, accomplished, by boiling the materials to be whitened, in alkaline leys, and steeping in weak acidulous solutions; which, together with mill-washing, and exposure to the sun, constitute the process of bleaching.

Bleaching by oxymuriatic acid.—Since the discovery of the oxymuriatic acid, a new era has commenced in the art of bleaching, and the wonderful effects of this agent have been successfully applied to both cotton and linen. This liquid consists of muriatic acid, or spirit of sea salt, as it was formerly termed, and oxygen gas; and the common mode of making it, is, by mixing certain proportions of sulphuric acid, manganese, and muriate of soda, and subjecting the whole to the process of distillation. The sulphuric acid uniting with the alkali of the salt discharges the muriatic acid, which, combining with the oxygen of the manganese, rises in the state of vapour, and impregnates the water in the receiver, in which a quantity of potash had been previously dissolved. To whiten the yarn or cloth, it is only necessary to immerse it in this liquor. There are, however, certain objections to this manner of using the oxymuriate, arising from its offensive smell and injurious effects on the health of the workmen. It was necessary, therefore, to obtain the acid in a more condensed state; and, accordingly, Mr Charles Tennent suggested the method of combining the gaseous vapour with lime, thus producing the oxymuriate of lime, which, being cheaper than that of potash, is now generally used in preference to any other mode of applying the oxymuriatic acid. For this invention he obtained a patent.

This compound being in a dry state, is easily carried from one place to another; and to produce a liquid fit for bleaching, it is only necessary to mix a certain proportion of this bleaching salt with a specified quantity of water: the yarn or cloth is then immersed in the liquid, and the acid immediately acts; but, in most cases, frequent immersions are required, particularly when the material is flax or hemp. The effect of oxymuriatic acid on cotton is so rapid, that it may be fully whitened in an hour. Instances, indeed, have occurred where the cotton has been spun, woven and bleached, in the course of one day.

The discovery of bleaching by oxymuriates, has been attended with important consequences to cotton and linen manufacturers, as the expedition with which they finish their goods, saves the long outlay of capital which the old method of bleaching required.

This method of whitening cloth is not yet generally practised, being only partly used in conjunction with the common process; and it is doubtful if the oxymuriatic acid could be profitably applied to bleach linen without the assistance of boiling in alkalis, mill-washing, and exposure to the sun.

In Scotland there are above 250 bleach-works, of which more than 100 are situated in the neighbourhood of Glasgow, Paisley, and Perth. At many of the bleachfields, there is powerful machinery employed, such as wash-wheels and stacks, rubbing boards, beetling machines, calenders, &c. &c. About 4000 hands are engaged in the bleaching business, mostly females, who are in the proportion of four to one. The weekly wages paid are, on the average, for men 18s. and for women 6s. The consumption of the various articles used in this business, such as coals, ashes, soaps, starch, blue, acids, manganese, lime, bleaching powder, &c. will amount annually to about 260,000*l*. Sterling.

3. HATS.

The hats generally manufactured in Scotland at present are of three different descriptions, viz. *Wool*, *Plated*, and *Stuff*. 1. Woollen hats are made entirely of that article, but of different qualities according to the price, which seldom exceeds 7s. each. 2. Plated hats are made of wool in the body, and covered with beaver's or hare's fur, and sold at from 7s. to 10s. 3. Stuff hats are made of a composition of beaver, coney wool, camel hair, and Spanish wool; and sell from 12s. to 30s. each. Beaver is brought from Canada and Hudson's Bay. Coney wool is taken from the skin of the rabbit; and camel hair is obtained from Turkey and the Levant.

The manufacture of hats has never been carried to great extent in Scotland. Till within these 20 years it was extremely limited, but has been gradually increasing since that time, and is now carried on to considerable extent, particularly in Edinburgh, Glasgow, Dumfries, Greenock, &c. There are at present more stuff hats made in Edinburgh, than at any former period; where, from the attention paid to their manufacture, they are generally esteemed equal in quality to the best made in London. The greatest number of the hats made at Glasgow, are of the wool kind, intended for exportation; while those manufactured in Edinburgh are sold almost entirely in Scotland, and have to rival the English hats of the finest qualities.

The extent of this manufacture may be estimated at about 200 journeymen employed in making, besides finishers, liners, &c. the majority of whom are at Edinburgh and its vicinity; and the whole amount of the value of the hats manufactured in Scotland may be about 60,000*l*. Sterling annually.

It is stated as a great obstacle to the increase of the manufacture of hats in Scotland, that there subsists, among the journeymen, an organized system of depredation, which the manufacturers have never been able to suppress.

Straw Hats.—The manufacture of this article was lately introduced into Scotland. The straw is prepared chiefly in London, and plaited in various places, as far north as even Thurso in Caithness, where about 250 women and young girls are employed. The straw-plait is sent to London, to be made up in hats and bonnets for ladies. A great quantity of straw-plait is also made in Zetland. In Edinburgh, Glasgow, Aberdeen, and in the other towns of Scotland, the making up of hats and bonnets forms employment to a number of females.

4. PAPER.

The materials of which this article is made, are, rags of linen, cotton, &c. but chiefly of the first, which produce the best quality of paper. After the rags have been properly sorted, they are subjected in water to the action of machinery. This reduces them to the consistence of a thin pulp, into which, moulds, the size of the sheet, are dipped. The bottom of the mould is a sieve of fine brass wire, through which the water filters leaving the pulp in the state of paper, when it is removed to a felt to be thoroughly dried and properly pressed. A method of making an endless sheet, or a web of paper, has been introduced under letters patent; and machinery for that purpose was lately erected in the neighbourhood of Aberdeen. This invention, however, is not yet generally practised in Scotland, owing to the high price charged by the patentee for the machinery; and, for the most part, the manufacturers adhere to the old method of making paper by oblong square moulds.

The paper manufacture comprehends an immense variety of qualities; but those made in Scotland are chiefly the coarsest kinds. The general opinion of the consumers is, that the Scotch finer papers are inferior to those of Kent and Middlesex; and the consequence is, that the paper mills of Scotland are employed principally in fabricating printing and packing papers of all the various qualities and sizes required by the country. Mill-boards, pasteboards, pressing papers, and all kinds used for the package of goods, possess a decided superiority over those of English manufacture; and to these kinds, the attention of the Scotch paper manufacturers is principally directed. The coarser sorts of printing papers are also preferred, owing to their better quality, and there is a considerable demand for them in the English market.

Blue, black, and purple paper are made in considerable quantities, and extensively used in packing and finishing various articles, such as cotton and linen cambrics, shirtings, threads, tapes, hosiery, &c.; and also the common blotting paper which is consumed in the manufacturing and mercantile towns.

The consumption of printing papers for low-priced publications, such as ballads, jest books, romances, pslams, testaments, bibles, &c. &c. is very considerable; and newspapers, magazines, reviews, posting and hand-bills, form another source of demand for paper of almost every description. Paper used for hangings is also manufactured in Scotland.

The total number of paper-mills in Scotland is about sixty, employing between three and four thousand persons. *

The excise duty collected on paper for the year ending the 5th January 1813, amounted to 42,787*l.* 16s. 5½d.

5. IRON.

The manufacture of iron has been carried of late years to great extent in Scotland, both in extracting the metal from the ore, and in converting it afterwards to various important purposes.

Iron is extracted from the ore of iron-stone by smelting: it is then termed pig-iron, which by a further process may be made into malleable iron, and afterwards into steel.

Iron Manufactories.—The most extensive manufactory in Europe is that of Carron, near Falkirk, which was established in 1760. The quantity of iron smelted is 6500 tons yearly, and about 2000 people are constantly employed. There are 12 Iron works in Scotland, and in all 21 blast furnaces, at 19 of which charred coal, and at 2 in Argyleshire, charred wood are used; the whole of which produces, on an average, 30 tons of iron each per week, or 32,760 annually, which, at 7*l.* per ton, amount in value to 229,320*l.* Sterling. They likewise employ 7620 people in the different operations of the manufacture.

Besides these works where pig-iron is made, there are between 40 and 50 foundries in Scotland, at Edinburgh, Glasgow, Paisley, Greenock, Ayr, Dumfries, Kilmarnock, Perth, Dundee, Arbroath, Montrose, Aberdeen, Dunbar, &c., 11 of which are at Glasgow alone; and the whole employ upwards of 1000 hands.

A part of the pig-iron made in Scotland is exported to England, Ireland, and America; but the greatest consumption is by the foundries at home, which convert it into an immense variety of articles, such as agricultural implements, manufacturing machinery, including steam-engines and water-wheels, cisterns, boilers, pipes, domestic utensils, &c. It is also applied in building bridges and houses; in pillars for churches, warehouses, and manufactories; in erecting railways, and to an endless variety of other useful purposes. Its annual value is computed at 500,000*l.*

The application of iron, in its three different states, of pig-iron, malleable or bar iron, and steel, is so very extensive and minute, that it is impossible to ascertain either the extent or value of the articles fabricated. Bar iron and steel are forged by blacksmiths into all sorts of culinary and other domestic utensils; agricultural implements; ships' anchors, bolts, &c.; boilers for

* At Ballerno-Bank mill, near Edinburgh, a new species of paper has been made from the refuse and cuttings of leather, which resembles parchment. It is well calculated for many useful purposes, and the manufacture is as simple as that of common paper.

steam engines, and other purposes; axles for machinery, &c.; and many other articles of great utility. A considerable proportion of Scottish ironmongery is exported to America, the West Indies, and other British colonies, such as anchors, bolts, waggon axles, sugar-mill gudgeons, wedges, and various articles of mill and steam-engine work, with domestic utensils of every kind, as well as hoes, axes, adzes, hammers, and similar tools.

1. *Lock and Hinge Makers.*—From the great increase of manufactures and commerce of late years, locks and hinges have been much wanted for the many buildings erected in consequence; but the class of workmen who make these articles are not very numerous in Scotland, the market being supplied chiefly by the English manufacturers.

2. *Card Making.*—Since the vast increase of spinning machinery in Scotland, there has been an increased demand for cards. There is an extensive establishment in the vicinity of Edinburgh. The wire is drawn by the power of horses or steam, and the teeth of the cards, after being properly shaped by a machine, are set in the leather by boys and girls. *

3. *Tinsmiths.*—Since the introduction of machinery for the manufacture of cotton and flax, the tinsmith's business has greatly increased. The number of rollers, drums, cans, &c. for spinning mills, together with pipes for heating buildings by steam and warm air, domestic utensils, japanned, painted and white articles required in Scotland, and for exportation, give employment to about 500 hands. The iron of which these articles is made is previously rolled into thin sheets, termed sheet iron, which, after being tinned, is called tin plate.

Gun Making.—There are only ten gunsmiths in Scotland, six of whom are in Edinburgh. They receive the barrels in a rough state from England; but they make every other part themselves. This manufacture is confined to fowling-pieces, which are sold at every price from six to forty guineas. Scotch fowling-pieces are much esteemed; and Mr Innes of Edinburgh, makes them with ingenious locks which are water tight. The Highlands were formerly celebrated for the manufacture of pistols, made entirely of iron, which sometimes cost as high as 40 guineas the pair. That manufacture, however, has greatly fallen off.

Cutlery.—This branch is not carried to any considerable extent

* Mr Stead, the proprietor of this manufactory, has obtained a patent for his cards. The improvement consists in pointing the teeth like needles, which separates the fibres of the flax, cotton, &c. more completely than common cards, and, consequently, the work is better performed. He also makes iron and brass wire of a quality superior to any other in the kingdom, and for musical instruments it is preferred to the best German wire. The moving power of this manufactory is a steam engine, of the most perfect construction. The wheels are cut out of solid iron, and so exactly fitted, that the whole move with scarcely any noise, and this engine has attracted the attention of many strangers as a piece of superior mechanism.

in Scotland, almost the whole of the edge tools used, being brought from Sheffield or Salisbury, where the art of manufacturing every thing of this nature has arrived at great perfection.

Cutlers may be divided into two classes. 1*st*, Those who remain stationary in the different towns; and, 2*d*, Those who travel from place to place with portable cutling machines, which are wrought by the foot.

The first class are chiefly superior workmen, employed in fabricating surgical instruments, scissars, pen-knives, razors, &c. of a good quality and high price. The second class are itinerant workmen, who grind knives, scissars, razors, and other edged instruments, and make a livelihood in this way, in the streets and lanes of the different cities and towns of Scotland.

As the English manufacturers principally supply the Scotch market, both for exportation and home consumption, with cutlery and hardware articles, the extent of these branches of the iron trade, as well as the number of workmen employed, is inconsiderable.

6. COPPER, LEAD, TIN, BRASS, SILVER, &c. &c.

1. *Copper*.—Although there be many indications of this metal in different parts of Scotland, and the Islands, yet copper-mining has hitherto only been attempted at Arthrey in Stirlingshire, and in Fair Isle, one of the Zetland Islands, where, in the space of two years, from June 1802, about 473 tons of ore were raised. This mine has been abandoned; but in the opinion of several well informed people, it might still be wrought with advantage. Copper has likewise been found in the Ochil hills, near Stirling. All the copper, however, used in Scotland by coppersmiths, and for copperplate printing, ship-sheathing, &c. is obtained from England and Wales.

The use of copper culinary utensils has been much superseded of late years, by those made of tinned plate and cast-iron, owing to their cheapness, and the danger to be apprehended from the oxidation of copper vessels. The coppersmith trade, however, still continues to support itself, chiefly by the numerous orders obtained for boilers and distilling apparatus for the West Indies, &c. and for home consumption. Copper tea-kettles, coffee-pots, backets, goblets, scales, scoops, measures, and similar articles, are made to considerable extent for both foreign and home sale, besides various pipes for the different chemical, bleaching, printing, and other works.

2. *Lead*.—The application of lead is very extensive in the manufacture of ridges, gutters, rain-pipes, roofing of domes, and other parts of buildings, cisterns, conduit-pipes, &c. The fabrication of these articles is properly the business of the plumber, who uses tin for soldering the lead. Tin has not been found in

Scotland, and is therefore imported from England, where it is a valuable article of commerce.

The number of plumbers, is not very considerable in Scotland, but daily increasing, from the augmented demand of the articles they make, by the erection of buildings, the conveyance of water by pipes, and for other useful purposes.

3. *Tin.*—Although this metal be not a natural production of Scotland, yet it is imported from England; and when mixed with lead, constitutes pewter, which is manufactured into various articles; as table and tea spoons, measures for spirituous and fermented liquors, &c. The use of these articles is now extremely limited, in consequence of the introduction of stoneware plates, basons, &c. plated iron-spoons, and glass measures, which in a great degree have supplanted pewter articles. The number of workmen, however, employed, either in the pewter manufacture or in tinning, is inconsiderable in Scotland.

Tin is much used for distillers' worms, and plumbers' and tinsmiths' solder. A good deal is also consumed by the dyers, in a state of solution, in different *menstrua*. But the most extensive application of this metal, is in coating culinary utensils, made of cast-iron or copper,—which operation is termed *tinning;* and when properly performed, in a great measure prevents the oxidation of these metals.

4. *Antimony.*—A mine of this metal has been wrought at Glendinning, in Dumfries-shire, and produced 84 tons of the regulus of antimony, worth 100*l.* per ton, in the space of about four years. The principal consumption of this metal, is in the art of typefounding.

5. *Types.*—There are only two Type Foundries, on any important scale, in Scotland; one in Glasgow, established about 60 years ago, and employing from 40 to 50 hands; the other in Edinburgh, begun about the year 1807, and employing from 30 to 40 workmen.

6. *Brass Articles.*—Brass-Founders are a numerous class, and they seem to enjoy a successful trade. Great quantities of castings are required for cotton and flax machines, candlesticks, and other utensils; also water-cocks and valves for domestic purposes, but particularly for the immense number of steam engines, bleaching, chemical, and other apparatus, which stand in need of frequent repairs, as well as bushes, steps, &c. for colonial machinery, which altogether afford constant employment to the brass-founders.

7. *Pin Making.*—The manufacture of pins from brass, was lately introduced into Scotland, but without much success; a few, however, are made at Edinburgh, Glasgow, and Aberdeen. English pins are preferred from the superior neatness of the workmanship, and nearly engross the Scotch market.

8. *Watch and Clock Making.*—Watch-making in Scotland consists chiefly in fitting up this useful machine; the different parts of which are of English manufacture. This class are therefore principally employed in repairing watches, and they are also in general clock-makers. Clocks are made in Scotland from the rude materials, with the exception of the spring and some other parts, which are brought from England. When it is considered, that almost in every cottage, as well as in the houses of the opulent, a clock is to be found, it will not appear surprising that this class should be very numerous, and that watch and clock-makers are established in almost every town, and in many villages.

8. *Jewellers, or Gold and Silver-smiths.*—Jewellery articles are for the most part of English manufacture. A few workmen, however, are employed in Edinburgh, Glasgow, and others of the large towns. A good many small articles are made in Scotland, both for home consumption and exportation; but the class of gold and silver-smiths is not numerous, in consequence of the great influx of these articles from England.

9. *Gilders and Platers.*—The art of Gilding is not carried to much extent in Scotland, and there are but few workmen. The frames of pictures and mirrors are the chief articles finished by this class, who are almost entirely confined to the cities of Edinburgh, Glasgow, and Aberdeen.

7. THE MANUFACTURE OF THOSE ARTICLES IN WHICH TIMBER IS CHIEFLY EMPLOYED.

1. *Joinery and Cabinet-making, or Articles of Household-Furniture.*—Joiners, called also *Wrights* or House-Carpenters, are the most numerous class of workmen in wood, and are found in every town and village in Scotland.

Cabinet-makers are also a numerous class in all the large towns. Nine-tenths of the timber used by them, consist of fir imported from America, and the north of Europe. The finer kinds of the articles they deal in, were formerly brought from London; but the greater part of the masters having practised the trade in that city, cabinet-making is now well understood in Scotland, where the working of mahogany and hard-wood has been brought to as much perfection as in England. Besides the demand for articles of this nature at home, considerable quantities are exported to Ireland and the West Indies.

2. *Machinery, and Utensils of Husbandry.*—Since the introduction of cotton and flax mills, thrashing mills, and other machinery, by which of late years labour has been so much facilitated, artisans in this department are in great request. Some idea may be formed of the number of workmen employed, and the value of the articles they make, when it is known that in Scotland there are about 3600 water-mills, 5000 thrashing-mills, above 100 wind-mills, and from 350 to 400 steam-engines, em-

ployed in preparing flour, meal, barley, snuff, bark, and lint; for teazing, carding, roving, and spinning wool, flax, and cotton; for preparing dye-stuffs, bleaching salts, paints, fire-clay, &c.; for winding, weaving, tambouring, printing, washing, wauking, calendering, &c.; for boring, blowing, hammering, &c.; and for raising water and minerals. The manufacture of machinery is therefore a most important branch of Scottish industry, as not only all the internal mechanism necessary for these operations is to be made and fitted up, but also the primary movements, as the water-wheels, wind-mills, and steam-engines themselves; and the whole must be upheld in proper working order.

Cart and Plough-making.—This forms an important branch of the mechanical art; and cart and plough-wrights are found in every district of the country. Besides carts, waggons, and ploughs, it includes many other agricultural implements, and sometimes, though not often, fanning, thrashing, and other machines. Of late years, several ingenious improvements have been made on the plough, for the various purposes of the common and drill husbandry. Ploughs of iron, both malleable and cast, have been introduced, and are likely to answer well. It would be difficult to ascertain with accuracy the number of cart and plough-wrights employed in Scotland; but besides those in the towns and villages, there is one or more in almost every parish of the country. A number of farming implements, have of late years been exported to England, and to foreign parts; and this trade is regularly on the increase.

Coach Making.—The business of coach-making is carried on in Edinburgh, Glasgow, Perth, Aberdeen, &c. but not to any considerable extent. The progress of luxury, and the excellent roads every where in Scotland, have both contributed to the extension of this manufacture, which is daily increasing. Coaches, chaises, gigs, &c. are now finished in this country, in a manner little, if at all inferior to those of London; and besides the home consumption, a few are exported to Russia, and the other ports of the Baltic, to the West Indies, and to America.

Musical Instrument Making.—Piano-fortes are made at Edinburgh and Aberdeen. Flutes, fifes, and similar wind-instruments, are made at Edinburgh, Glasgow, and at one or two more towns, but the quantity is trifling; and the same may be observed in regard to the Scottish great, and the smaller Irish bagpipes. Most of the clarionets, hautboys, flutes, &c. are brought from London, as well as metallic stringed instruments, organs, French and bugle-horns, trumpets, &c. and the greater part of the violins. There are several persons in Edinburgh, who live by making and mending violins. Piano-fortes, however, and other musical instruments, are chiefly of London manufacture, and are generally preferred as still rather superior to those of Scotland, in both tone and finishing.

Trunk and Box Making.—The demand for travelling and other trunks is considerable in Scotland; and many kinds of fine goods, as muslins, tapes, threads, &c. are exported in trunks, great numbers of which are consequently made. They are constructed of fir, and covered with horse and other skins, which are imported chiefly in a dried state from South America. Trunks being easily locked and opened, are more convenient, and preserve their contents better than packing-boxes; of which, however, great quantities are made. The number of workmen employed in making trunks and boxes is very considerable, and they are to be found in all the larger towns in Scotland.

Baskets and Wicker Work.—Since the introduction of the cotton and flax trade into Scotland, a great quantity of baskets are required for holding cardings, rovings, copes, bobbins, &c. The demand for these, as well as for market baskets, cradles, creels, and all other articles composed of wicker work, has of late years much increased. There has lately been introduced at Leith a new manufacture of basket-work, formed of whalebone, which, from its toughness and elasticity, is wrought to considerable advantage in hats, chair bottoms, sieves, &c. This manufacture, together with its application in brush-making, are new channels for the consumption of whalebone, which was formerly used in little else than in the construction of umbrellas, parasols, and ladies' corsets.

Brush-Making.—This manufacture has considerably increased of late years in Scotland; and it is carried on at Edinburgh, Glasgow, Falkirk, Dundee, and Aberdeen. About 200 hands are employed; and a journeyman may earn at this business from 25s. to 30s. weekly, though the general average wages is about 22s.

Besides hearth, and other brushes for clothes, shoes, and various domestic purposes, large quantities are made for the different cotton and flax works; and weavers' brushes also form a considerable branch of this manufacture.

Native birch, plane, elm, ash, and several other kinds of hard wood, besides mahogany, are used in brush-making. The bristles of many of the brushes are wrought into the wood with wire, and those of others are fastened with pitch. The bristles are obtained from the Russian, and other ports of the Baltic; and the best quality is sold so high as from 24*l*. to 27*l*. per cwt. A substitute, however, has been lately introduced under letters-patent, and whalebone is now much used. It is heated and sliced down into small fibres, resembling bristles, and found to answer for most purposes. The use of this substance, of which great quantities are annually obtained from Greenland and Davis's Straits, has tended to prevent bristles from rising higher than they are. At one of the brush-works in Glasgow, a steam-engine is employed for driving the machinery, which consists of turning laths, circular saws, slicing tools, and other instruments.

Cooper Work.—This has become a very extensive trade in Scotland; in consequence, 1*st*, of the increase of distilleries and breweries: 2*d*, The immense importation of rum from the West Indies: 3*d*, The vast number of barrels used in the herring fishery, both at home and abroad: 4*th*, The great quantity of casks, barrels, tubs, and similar vessels employed in the operations of bleaching, dyeing, calico-printing, and other chemical processes: and, 5*th*, The increase of shipping and whale fishing, which require numerous casks for holding fresh water, and butts and other vessels for oil and blubber.

The staves used in cooper work are oak, and principally obtained from foreign countries. Into the Clyde alone, during 1812, staves to the number of 357,656 were imported, which would produce from 20 to 30,000 casks, and other vessels. The hoops used are generally obtained at home from different species of the willow tribe, and other pliant woods. Iron hoops are also used, and they are rolled out with great accuracy at the works of Dalnotter, Muirkirk, Cramond, and others.

In the neighbourhood of Glasgow, there is a saw-mill driven by steam, which blocks out great numbers of cask staves with circular saws; and one man can perform as much work by this machine, as a dozen could execute by hand in the common way. An extensive establishment has recently been erected on the bank of the great canal near Glasgow, exclusively for the manufacture of casks, and other articles in the cooper line: many of the operations are performed by machinery, driven by a powerful steam-engine. Upon the whole, from the extent and ready demand for articles of this description, occasioned by the increase of commerce, manufactures, and fisheries of Scotland, the cooper trade is deemed very profitable.

Ship Building.

This business is carried to considerable extent in Scotland, and forms an important branch of national industry. Dock-yards, for building and repairing vessels, are established at all the principal sea-port towns along both coasts. The description of vessels for the most part built in Scotland, may be termed commercial; for, with the exception of several frigates, and some smaller ships for the public service, few have been built for any other purpose than that of trade and the fisheries. At Greenock, Port-Glasgow, Ayr, and other places on the west coast, ships of large dimensions are built for the West Indian, American, and foreign trade; and at Leith, Dundee, Aberdeen, &c. they are chiefly smaller vessels for the European commerce, the London trade, and the fisheries. Besides these, a number of cutters, sloops, schooners, are built in the several dock-yards, peculiarly adapted for a coasting trade in boisterous seas and high latitudes; and when the flat-bottomed vessels, from 30 to 40 tons burthen, employed on the navigable rivers, friths, lakes, canals, &c. are added, together with the number of boats for crossing ferries, and catching fish, it will be found, that the Scottish ship and boat building business is of great national importance.

The annual average of the number and tonnage of vessels belonging to the ports of Scotland, amounts to 2509 vessels, 202,318 tons, of which three-fourths are probably Scotch; or 1882 vessels, 151,739 tons: And supposing the loss occasioned by capture, wear, and accidents, to be 7 *per cent. per annum*, the annual building, on the average of those ten years preceding 1812, will amount to 134 vessels, 10,838 tons. Estimating the expense of building, rigging, &c. at 20*l.* per ton, or in all 216,760*l.*; and the repairs required at 20 *per cent.* on that sum, the whole amount of the money expended in ship-building, repairing, &c. in Scotland, will be 260,112*l.* Sterling annually.

8. TANNING,

Or the Manufacture of Hides into Leather.

The conversion of the skins of animals, or raw hides, into leather, is performed by the process of tanning. This process has been understood from the earliest times; and about the beginning of last century, the tanning business became an object of importance in Scotland, and is now successfully carried on in almost every town there, in many of which there are also curriers and tawers.

The tanning process is extremely tedious, some of the heaviest hides requiring upwards of twelve months before they are ready for market, and, consequently, a large capital is requisite for conducting this trade. Many practical tanners, however, have made considerable improvements tending to shorten the process, by means of acids, but particularly by heat, which expanding the fibres of the skin, renders them more accessible to the action of the tanning matter.

Besides those skins produced in Scotland, large quantities are imported in a salted or dried state from Russia, and the ports of the Baltic—from Ireland and America—and from Mogadore and Sierra Leone in Africa. These hides are manufactured into various descriptions of leather, the surplus of which, after supplying the consumption at home, is sent chiefly to London.

1. *Shoes and Boots.*—In every town and village, and in every parish, shoe and boot-makers are found, and they constitute one of the most numerous classes of craftsmen in Scotland. Those in villages, and in the country parishes, are principally employed in making and mending shoes and boots for the consumption of their immediate neighbourhood. But, in the larger towns, regular manufactories are established, where the business is conducted by a master employing journeymen and apprentices.

2. *Gloves, Breeches, &c.*—Buff, shamoy, and buckskin leathers, dressed in oil for soldiers' belts and other accoutrements; gloves, breeches, aprons, &c. are prepared in considerable quantities at Silvermills near Edinburgh, Pollockshaws near Glasgow, and some other places. The skins, which are chiefly those of the cow, calf, sheep, and deer, after having been charged with oil, are subjected to a process of milling, similar to that of wauking or fulling.

3. *Saddlery, Harness, &c.*—The saddlery business is carried on to a great extent in the towns, villages and hamlets of Scotland. In the towns, saddles, harness for every description of carriages, belts for machinery, &c. are chiefly made; and in the villages and hamlets, the business is confined almost entirely to making and repairing harness for agricultural horses. The manufacture of whips and thongs, is very inconsiderable. There is only one establishment, which is situated at Edinburgh. There are some thongs made at Hawick and other places; but the consumers of these articles are chiefly supplied from England.

4. *Bellows-making.*—In Edinburgh, Glasgow, and in some other of the principal towns, bellows are made both for smiths' forges and for domestic purposes.

The leather trade in Scotland, on the whole, employs a great number of hands in all the different operations, from the time the skins are taken off the animals, until they are prepared and made up into shoes, boots, saddlery, harness, and various accoutrements; whips, furriery, caps, leggings, and pocketing; gloves, breeches, machinery belts, covers of coaches, sedan and other chairs; trunks, books, rollers, and balls; besides being used for cards, sieves, pipes, valves, and various other purposes.

The duties paid on hides and skins in Scotland, for the year ending the 5th January 1813, amounted to 48,774*l.* 7s. 8¼d.

9. MALTING, BREWING *and* DISTILLING,

Or the Manufacture of Grain; consisting of several separate Branches.

1. *Malting.*—The process of malting consists in exciting the vegetative power of grain, which is accomplished by immersion in water for a specified time, and the heat arising from partial fermentation, in consequence of the grain being laid in heaps, or spread on the floor to a certain thickness, varying according to circumstances. Thus situated, the grain springs or vegetates; and the farinaceous substance of the grain is converted into saccharine matter, which is soluble in water.

Malt was formerly made to great extent at the sea-port towns along the coasts of Scotland for exportation to Norway, the Baltic, &c. as well as for home consumption. Of late years, the state of Europe and other circumstances have prevented exportation, and the trade of the maltster is now more rarely a separate business. In the country, private families make malt for their own brewing; and, in the towns, the consumers of beer, ale, and porter, are supplied, with few exceptions, by the regular breweries of Scotland and England.

The gross duty on malt in Scotland, for the year ending the 5th of January 1813, was 163,445*l.* 16s. 3d.

2. *Brewing.*—Breweries are established in every town, and frequently in villages; and at Edinburgh, Glasgow, Perth, Dundee, Brechin, Montrose, Aberdeen, Elgin, Inverness, &c. there are very extensive works where small beer, ale, and porter, are made in great perfection. In the article of porter, they now rival those of London in both the home and foreign markets; and, in regard to strong ale, the breweries of Edinburgh, Dundee, Aberdeen, Elgin, Alloa, and others, have been long celebrated.

The duty which the Scotch breweries paid on beer, for the year ending the 5th January 1813, amounted to 78,389*l.* 16s. 7½d.

3. *Distilling.*—Distillers generally make their own malt; but they frequently use raw grain as well as malt, which is mashed with water heated nearly to the boiling point, and the solution is fermented. The process of distillation has been much improved within these few years, so far as expedition is requisite; but the facilities afforded by the construction of the stills, have not improved the quality of the spirits, which are now no less deleterious to the human constitution than formerly. Besides the consumption at home, considerable quantities of Scotch spirits are sent to the rectifiers of England, and also exported to the coast of Africa and other parts of the world.

The principal distilleries iu Scotland are at Kennetpans; Kilbagie on the Forth; Hattonburn near Kinross; Carsebridge and Hole, near Alloa; at East Linton, Borrowstounness, Linlithgow, Underwood, Kippen, Cowie, Inverkeithing, Kincardine, Kirkcaldy, Clackmannan; and several near Glasgow, besides those situated in the neighbourhood of Edinburgh.

The duty paid on British spirits distilled in Scotland, for the year ending the 5th January 1813, amounted to 593,188*l.* 13s. 1¾d.; but when distillation from grain is permitted, the revenue is much more considerable.

4. *Rectifying.*—This art was formerly carried to a great extent in Scotland; but the quality of the spirits produced was so inferior to those of foreign manufacture, that the demand for Scotch rectified spirits has now almost entirely ceased.

10. SUGAR REFINING.

The refining of sugar commenced in Scotland about the middle of the 18th century. This business, however, has not been carried to much extent, and is at present on the decline. The quantity of refined, bears but a small proportion to that used in the raw state in Scotland; indeed, the Scotch market is chiefly supplied with refined sugar from England.

The process of refining sugar is still conducted at Glasgow, Greenock, Port-Glasgow, Leith, Edinburgh, and Dundee; and consists in boiling the sugar with lime water, adding a little blood, which, together with the impurities, is brought to the surface, and removed by frequent skimming.

A new process for refining sugar has been lately introduced by a Frenchman. The principle on which this process depends is the same as that discovered by Lord Dundonald in regard to the purification of salt.

Sugar is now used by all ranks for a variety of purposes, and it forms a valuable material for distillation. Independent of the sugar refined in Scotland for home consumption, great quantities in this state are exported to the continent of Europe, the West Indies, and America. The value of the sugar consumed in Scotland annually, including the duty, may amount to about one million Sterling.

11. POTTERY.

This manufacture may be defined the art of converting particular earths into various compound articles, either for use or ornament; and it comprehends the following distinct branches.

1. *Bricks and Tiles.*—Brick and tile-making is carried on to a considerable extent in many parts of Scotland, especially where the material is abundant, and fuel easily obtained. Bricks are made about 9 inches long, 4½ broad, and 2½ thick, and they are sold for about 28s. per thousand. They are subjected to the heavy excise duty of 5s. 10d. on every thousand. There is a species of bricks termed fire brick, from the nature of the clay of which they are made. As they stand extreme heat, they are used for lining furnaces and flues, and are sold at from 4*l*. to 5*l*. per thousand.

Tiles for roofing are made about 13½ inches long, 9½ broad, and five-eighths of an inch thick. They are liable to a duty of 12s. 10d. per thousand. Tiles for pavement, floors of malt kilns, &c. are taxed higher in proportion to their respective sizes than the common kind.

The duty on bricks and tiles in Scotland for the year ending the 5th January 1813, amounted to 6651*l*. 17s. 10½d.

2. *Earthen-ware, Stone-ware, or Porcelain.*—Potteries for the manufacture of the coarse sorts of glazed and unglazed brown earthen ware are pretty numerous in Scotland, but chiefly established in the coal counties. The most extensive are those situated at Borrowstounness, Prestonpans, Stevenston, Cumnock, and in

the vicinity of Edinburgh, Glasgow, and some of the other large towns. The attempts made to establish the manufacture of stone or delft have not succeeded; indeed, Scotland is not well calculated for such a trade, as the clay employed is found only in Cornwall; and the long established manufactories of Stafford and Worcestershire, where both skill and experience are united, produce articles that command a preference in the market.

3. *Tobacco Pipes.*—This manufacture is carried on to a moderate extent in Scotland.

12. GLASS.

The manufacture of glass was introduced into Scotland in the 17th century, and is divided into the following branches; *1st*, Bottle—*2d*, Window—and, *3d*, Flint Glass.

1. *Bottle Glass.*—At Glasgow, Greenock, Leith, and Alloa, there are extensive works for black or common bottle glass, which supply the home consumption to a considerable extent, and also furnish a great many bottles for exportation.

2. *Window Glass.*—About the year 1776 large works for making this article were established at Dunbarton. The glass manufactured here is equal in quality to any in the kingdom; and, besides supplying large quantities for internal consumption, a great annual exportation takes place to America and the West Indies. These works employ about 300 workmen, labourers, &c.; and annually use 15,000 tons of coals, 38,000 stones of hay and straw, and nearly 1200 tons of kelp. There is a similar work established at Leith, but upon a smaller scale.

3. *Flint Glass.*—At Verreville, near Glasgow, there is a crystal or flint glass work, which is carried to great extent. The glass is considered superior in quality to that made at Newcastle, and other situations in the north of England. At this manufactory the goods are cut, polished, and otherwise highly ornamented; and the machinery for effecting that purpose is driven by steam. There are also extensive works of this description at Leith and Edinburgh. A great proportion of the coarser kinds of glass consumed in Scotland is imported from Newcastle; but the finer kinds are chiefly furnished by these manufactories.

The glass works in Scotland employ, altogether, from 1300 to 1500 hands.

On every description of glass a high duty is imposed, which, in the year ending the 5th January 1813, amounted to 94,339*l.* 15s. $4\frac{1}{2}$d.

13. SOAP, CANDLES, *and* STARCH.

The manufacture of Soap is extensively carried on, and three kinds are produced.—1. White—2. Brown—and, 3. Soft Soap. Tallow, oil, and alkali, are the ingredients which constitute this article; the whole being subjected to the process of boiling.

1. White Soap is made of tallow, and the solution of alkali rendered caustic by lime.

2. Brown Soap is made of oil, tallow, rosin, and the caustic solution :—And,

3. Soft Soap is a compound of oil and a solution of potash.

The manufacture of soap is carried on in all the principal towns in Scotland, the demand for domestic purposes being considerable, as well as that for bleaching and exportation. The soap manufacture is generally combined with that of candle-making; the finer kind of tallow being used for candle, and the coarser for soap. A great quantity of tallow is imported from Russia, the shores of the Baltic, and South America; but the ordinary slaughter of cattle generally supplies what is required by the inland and less populous districts.

The duty on soap made in Scotland, for the year ending 5th January 1813, amounted to 97,273*l.* 12s. 7¼d., and that on candles to 18,190*l.* 5s. 2¼d.

Mr Mitchell of Edinburgh has introduced a new ingredient in the manufacture of soap. He prepares a strong jelly from the skins of animals, but particularly from the offal commonly denominated *scrows*, which is the refuse of the tanners and tawers. To this, he adds a solution of the carbonate of soda, and the compound is mixed with the materials now in use for making soap to the extent of one-fifth part. The advantage of this discovery is, that scrows, formerly of little utility, can now be applied to a valuable purpose, besides the quality of the soap being much improved. Mr Mitchell has secured his invention by letters-patent; and soap of this description is now extensively manufactured in Scotland.

Starch.—The manufacture of starch was carried to considerable extent while hair-powder was in fashion; but of late years it has so much declined, that the duty levied on starch, for the year ending the 5th January 1813, amounted only to 2880*l.* 7s. 4d.

14. CULINARY SALT.

This useful article is a natural production, consisting of muriatic acid and soda. It is distinguished into three kinds, possessing similar properties.—1. Fossil, or Rock Salt.—2. Bay Salt.—3. Sea Salt.

1. Rock Salt is not found in Scotland, but it is very abundant in England; and immense quantities are imported from Liverpool for the use of the Scottish Fisheries.

2. Bay Salt is imported from the south of Europe.

3. Sea Salt is produced by artificial evaporation; and about 100 salt-pans are established along the shores of the friths and coasts of Scotland, for the purpose of making it. An ordinary sized pan produces nearly 3000 pounds of salt per week, and requires for fuel about 14 tons of small coal, which cost from 4s. to 7s. 6d.

per ton, according to situation, and other circumstances. Salt is subjected to an Excise duty of 6s. per bushel of 56 lib., and the selling price is about 9s.; so that this useful article is taxed more than double its prime-cost.

The duty paid on salt, for the year ending the 5th January 1815, amounted to 107,649*l.* 17s. 9d.

An improved method of making salt has been lately introduced, by Mr James Smith of Newton-upon-Ayr. His invention consists in successfully applying steam to heat the sea-water, for the purpose of evaporating to crystallization, which may be done in various ways; and in the particular construction of his apparatus. His boiler is 21½ feet in length, 11 feet wide, and 21 inches deep; made of iron, and covered with a top of wood, raised 3 feet. At the commencement of the process, the boiler is filled with sea-water to a convenient height, and the boiling is continued 24 hours. The loss occasioned by evaporation is supplied, by adding fresh quantities of sea-water, until the brine is to be reduced to the proper degree of concentration for running into the salting pan. This brine is now run into a wooden cistern, where it remains at rest during the time the salt is taken from the pan, and all impurities mechanically mixed with it subside, leaving it completely purified. The brine is then run into the crystallizing pan, which is an iron vessel, 40 feet long, 7½ wide, and 9 inches deep. A day's boiling produces as much brine as fills this vessel to the height of 4 inches; which being heated by the steam to 170 of Fahrenheit, produces 15 to 18 cwt. of salt, leaving the sulphates and muriates of magnesia and lime behind in a liquid state. The steam arising from the boiler is applied to heat other vessels containing water, which being concentrated by evaporation, is run into the boiler, and reduced to the crystallizing point. Thus, the heat of the fire and the heat of the steam are both employed to produce evaporation, and act, in a twofold degree, to effectuate the same object.

The advantage of Mr Smith's method is, that 10 cwt. of coals will make as much salt as 20 or 25 cwt. by the usual process; so that the saving of fuel is fully one half: besides, a better article is produced, as the salt is freed from all impurities, does not liquify, and is fit for many purposes to which the common kind made in Scotland is not applicable.

15. TOBACCO *and* SNUFF.

The tobacco manufactured in Scotland, is chiefly imported from America; and great quantities are consumed by all ranks.

1. Tobacco for chewing, consists of the leaves of the plant, spun by a machine into what is termed Twist or Pig-tail. The grist of this article is varied from the common size of about three feet to six feet per ounce. It is generally coiled up, and sold

in rolls—hence frequently termed roll tobacco; and the price is about 4s. 6d. per pound.

2. Tobacco for smoking is also made of the leaves, which are cut by a knife, and it is termed Shag, or Saffron.—This kind is made of the finest and most delicate leaves, and is sold at from 5s. to 7s. per pound. Habitual smokers, particularly among the lower classes, prefer twist; which being made of the stoutest sort of leaves, possesses the most powerful inebriating qualities.

3. Snuff is made from both stems and leaves; and it is known by the different appellations of Black Rapee, Brown Rapee, and Scotch, or Plain Snuff. The first kind is sold at about 4s. 6d. per pound; the second and third at 3s. 10d.; and compound sorts, according to their respective qualities.

Snuff mills have been erected in various parts of the country, where water-falls could be obtained; and there is one at Glasgow, driven by a steam-engine.

The import-duty on tobacco is $7\frac{1}{2}\frac{1}{6}$d. per pound, which must be paid before it leaves the King's stores; and the excise duty of 1s. 9d. per pound, which is collected every six weeks. A drawback, extending to nearly the whole of the duty, is allowed on exportation.

The excise duty on snuff and tobacco in Scotland, for the year ending the 5th January 1813, amounted to 147,884*l.* 19s. $10\frac{1}{4}$d.

16. COMBS *and* SPOONS.

1. *Combs.*—Combs are made of horn, tortoise-shell, or ivory; and the manufacture is carried on chiefly at Glasgow, Edinburgh, and Aberdeen.

Combs are usually cut with a saw, wrought by hand; and many of the fine ivory, and other kinds, with a machine, having a circular saw. There are three people in Glasgow, who cut some of their horn and tortoise-shell combs by means of pressure, the tool forming all the teeth by one operation. This machine possesses the singular advantage of producing two combs at once, by cutting the teeth of the one out of those of the other, thus saving nearly the half of the material, which, in the usual way, is sawn out and thrown away.

Besides the home consumption for combs of all kinds, particularly by weavers, who use them in combing their webs, considerable quantities are exported to the West Indies, America, &c. The extent of the trade, however, in a national point of view, is trifling; for there are only from 16 to 20 master combmakers in Scotland, who employ about 100 hands.

2. *Horn Spoons.*—This manufacture gives employment to a number of persons resident in towns, and to others who are itinerant, who perform also various other mechanical operations. The price paid for making a dozen of spoons, varies from 1s. 6d. to

5s., according to the degree of finishing, or work bestowed upon them. Both combs and spoons are generally stained, to imitate tortoise-shell, &c. by certain applications of acids, metallic oxyds, and lime. The shaving and chips of ivory are used in the composition of Frankfort black, and those of horn are mostly sold for manure at the rate of about 2s. per stone.

17. COAL, LIME, *and* MARBLE.

These minerals, as connected with manufactures, have been already treated of in a former part of this work, (Chap. I. Sect. 5.); but some additional particulars, connected with the subject of manufactures, may be here explained.

1. *Coal.*—This valuable mineral is found in the greatest abundance in several districts of Scotland: the quantity indeed is so great, that it may be deemed almost inexhaustible. Its utility in domestic purposes and in the arts, is well known; and it is now proposed to give an account of a new application of coal to produce light, which, from its novelty, and importance, requires a particular discussion.

In several parts of Persia, where the soil is bituminous, there issues copiously from the earth a vapour, which, being kindled by the natives, burns with great vividity, yielding heat sufficient to dress victuals. In several of the Pyrenees, the same phenomenon has been observed; also in various parts of Lancashire, Worcestershire, &c.; in the vicinity of coal mines, particularly near Wigan, where, in dry weather, eggs have been boiled by the inflammation of the vapour. From this Dr Clayton appears to have taken the hint; as, having visited the latter place in 1736, he produced the same effect in 1739,* by the distillation of coal in a close retort. The idea, however, seems to have lain dormant 52 years; as it was not until about the year 1791 that Mr Murdoch began his experiments on coal gas, with a view to apply it to the purposes of giving light in manufactories, &c.—being then ignorant of what Dr Clayton had done. †

Within these four or five years, several cotton, and one printwork, near Glasgow, and two or three other works on the east coast, have been lighted up with coal gas, which answers the purpose extremely well.

This process being new, it may be cursorily described, as practised on the large scale.

The coals from which the light is to be obtained, are put into a cast-iron *retort*, sufficient to contain about two or three hundred weight; this retort having previously been placed in a furnace, with fuel below it, ready to be kindled.

The *gazometer* is an oblong square vessel, about 16 feet in length, 10 broad, and 9 deep, with a bottom, and no top, ge-

* Phil. Trans. † Ibid. 1808.

erally constructed of thinly rolled sheets of iron, rivetted toge-
ıer; and in one instance, of a wooden frame, covered over with
kind of tarpauling. But whether the gazometer be made of
on or cloth, it is coated over with paint or tar, both out and
ıside, to render it completely air-tight.

This vessel is suspended, *bottom uppermost*, from the ceiling of
ıe house in which it is, by a chain over a pulley, with a coun-
erpoise, something similar to the manner in which a chandelier
hung; only the counterweight is made a little lighter than the
azometer, so as that the latter, preponderating, may always
ave a tendency to descend.

Immediately below, there is a *pit*, of rather larger dimensions,
ned with stone, brick, or wood. This being filled with cold
ater, the gazometer is allowed to sink; but which it will not do,
ntil an opening be made in the top of it, to allow the contained
ir to escape. When this is done, the gazometer, descending,
oon fills with, and becomes totally immersed in, the water.

The above mentioned opening being then closed, and a fire
indled in the furnace, its heat passing through the retort,* causes
ıe enclosed coal to give out a great quantity of gas, which (in
ıe shape of a brown bituminous vapour or smoke) passes from
ıe retort through a pipe immersed in the pit; and, rising up
ithin the gazometer, occupies its upper region, buoying it out
f the water, more or less, according to the quantity of gas that
below it. Here the gas, having come into contact with the
old water, soon loses all colour, and becomes transparent.

From the gazometer, pipes ramify in all directions of the work
here light is wanted: These are furnished with stop-cocks
herever found necessary, particularly at each aperture where
he gas is emitted; so that by shutting the cock, the light is in-
tantly extinguished, and when again opened, the gas issuing is
nflamed by a taper or any other burning body, and will continue
give light, so long as there is any gas remaining in the gazo-
ıeter. The mains, and some of the smaller pipes, are of cast
on; those leading to the different apartments, are malleable iron,
opper, lead, brass, tinned iron, or wood:—but all ought to have
small declivity, that the condensed tar may run off and not ac-
umulate, so as to choke up the passage. Where it is necessary
remove the light occasionally from one place to another, some
ave flexible tubes, constructed of leather, with a small spiral
ire within, the pressure of the gas outwardly not being sufficient
keep the tube inflated when it happens to bend sharply; others
se only a lead tube for that purpose, which serves a long time
efore it breaks.

* In this operation, the whole fuel spent in decomposing the pit-coal, is by no
eans wasted; as the heat it yields, enters into the gaseous products, and is
terwards faithfully given out when they are employed to furnish light. *Gilles-
e's Essay.*

One light, equal in intensity (by comparison of shadows) to that of a tallow candle six in the pound, consumes about half of a cubic foot of gas per hour. * A pound of these candles, one burning at a time, lasts 40 hours, and costs, say one shilling.

On an average, each pound of good coal produces three cubic feet of gas:—hence a foot of gas is nearly equal to an ounce of candle; † or 20 feet (to burn 40 hours) require 7 lib. of best coal, which, at 8d. per cwt., is one halfpenny.

But this disparity of 24 to 1, is by no means so great in practice as at first sight it may appear to be, as the interest of the outlaid money, tear and wear, attendance, &c. is very great.—This will best be seen on the large scale, by the following calculations, founded on minutes taken at two of the Gas Light establishments in the vicinity of Glasgow.

GAS LIGHT, DR.	
To 1000 lights, each equal in intensity to a candle six in the pound, and burning ten hours each, will consume 5000 cubic feet of gas; this will require 1666 lib., or 15 cwt. of good coal, at 8d. p. cwt.	L.0 10 0
To the same quantity of common coal for outside of retort at 6d.—(*N. B.* Dross is sometimes used for this purpose, but, requiring a great current of air, it is more dangerous for the retorts) - -	0 7 6
To attendance, 2 men keeping the retorts going night and day, as, when allowed to cool over night, they are long before they become effective in the morning.—(*N. B.* The watchman of the work sometimes officiates during the night; but where retorts are numerous, continual going is not absolutely necessary) - - - - - - - -	0 5 0
To one day's interest of sum sunk in buildings, retorts, gazometer, pipes, cocks, incidents, and laying, say 30s. each light, 1500*l*.—(*N. B.* In some cases the outlay exceeds, in others it is less than this, a good deal depending on local circumstances and economical arrangements) - - -	0 4 2
To one day's tear and wear, including new retorts, fire bricks, building, incidents, repairs, &c. 10 *per cent.* on outlay - - - - - -	0 8 4
	L.1 15 0

* The (circular) aperture through which that gas passes, with a moderate pressure, is nearly the 32nd part of an inch in diameter.

† 9419 ounces of tallow make one cubic foot.

CONTRA,	CR.
By 10 cwt. of coke, being part of the residuum of 15 cwt. coals enclosed in the retorts, or 2-3ds of the weight, say only at 8d. per cwt. - -	L. 0 6 8
By 75 lib. coal tar, additional residua, or 5 per cent. of the weight of the coals—say only - -	0 6 0
Net cost - - - - - - -	1 2 4
N. B. This is about 10 lights per hour for 1 farthing, or one fortieth of a penny for each light.	
	L. 1 15 0

Now, 1000 candles, burning ten hours each, or, what is the same thing, 10,000 candles one hour each, will consume 250 lib., which, at only 1s. per lib. will amount to 12*l.* 10s. Hence the difference in favour of gas light to that of candles, in the coal counties of Scotland, is about eleven to one.

But this disparity, even great as it is, is not so much when the work is small, and the number of lights not numerous. Besides, the attention it requires and excites, counterbalances a good deal of the savings. Accidents sometimes also happen from inattention; as, when a large quantity of the gas gets mixed with atmospheric air, and the compound inflamed, the explosion is very dangerous.

A few years ago, several shops—first, in Glasgow, then in Edinburgh, and other towns—were lighted up with this gas; but it required so much management and work,—produced so much heat and smell, when the tubes leaked, and all not in proper order,—that few have persevered in using it. Indeed, it is only on a large scale that it, as yet, can be employed with advantage.

Scotland lying mostly between the 55th and 60th degrees of northern latitude, her days, in winter, are necessarily very short; the shortest being little more than from nine A. M. till three P. M.; and, particularly in that season, often rendered, by meteorological causes, very obscure. Hence, the annual consumpt of oil and tallow for producing light is very great. If each individual requires half an ounce of either of these, or one hour's light daily, on an average, the weight for one year is 9165 tons; which also averaging, at 55*l.* per ton, exceeds half a million Sterling. So that, whatever savings can be introduced into this department, must necessarily diminish, besides oil, the quantity of tallow purchased from foreign powers.

2. *Lime.*—The advantages of lime, which Scotland possesses, are very great. From the abundance of calcareous stone, as well as coal, it is obtained very cheap. Without this, it could not be so beneficially applied to most of the purposes for which it is so conspicuously formed: such as, building and manuring; as a flux in iron making; also in sugar refining, bleaching, and

for various other minor purposes. The lime trade is prosecuted to a great extent, not only for home consumption, but also for exportation, chiefly to the West Indies.

3. *Marble.*—This mineral is found in many parts of Scotland. There are also several quarries in Assint, in Tiree, and on Lord Macdonald's estate in the Hebrides; also at Cambuslang, &c. where marble of various qualities, and beautifully variegated colours, are obtained; but they are not much in demand. The surface of some of the Hebridian, do not admit of so high a polish as others, from their composition not being quite uniform. Since the war began, Italian, and other foreign marbles, have not been much used; the greater part of the marble works being supplied from Kilkenny in Ireland. A good deal is cut and polished, for chimney-pieces, hearths, monumental purposes, &c. and exported to America and the West Indies.

Besides the foreign trade in the above articles, large shipments to London are made of the following; viz.

4. *Stones.—Aberdeen Granite,* for bridges, piers, pavement, kirb-stones, &c. This granite has never been known to show any symptoms of decay.

Paving Whin, from North Queensferry, Salisbury Craigs near Edinburgh, &c.

Freestone, of almost any dimensions.—The quarries most celebrated, are those of Mylnefield near Dundee, Craigleith, and Hailes, in the neighbourhood of Edinburgh. Freestone of a superior quality is also found at Scrabster, near Thurso, in Caithness; and at Collalo in Fife.

Paving Freestone.—The quarries of Carmyllie, near Arbroath, are famous for paving freestone, and are the most esteemed in Scotland. The stones are easily quarried; of various thicknesses; large dimensions; and so smooth, that they require little dressing, yet are hard and durable. These advantages, however, are lessened by the tedious land carriage to the port of shipping (Arbroath), distant seven miles, and without a railway. Besides being used for paving halls, lobbies, corridores, &c. they are applied for casing brick fronts; and even in Scotland are used as veneers, when the inner walls are rough stonework.

Oven soles are got from St Catharine's, in Argyleshire, and several quarries in Ayrshire; but those from the latter are at present most esteemed. When well cut, and built in, they form a durable and cleanly sole for the baker's oven, and neither crack nor blister by the heat of his fire.

Slates are obtained in large quantities from Ballachulish, in Inverness-shire, and from the island of Easdale, in Argyleshire; a few also from Camstradden, in Dunbartonshire, Bute, &c. The sale of Scottish slates in England is not considerable, owing to the excellent quality of the Welch slates, which are in general use.

18. MISCELLANEOUS ARTICLES.

There is scarcely a profession or trade, however rudely conducted, that does not, in some degree, require the union of chemical and mechanical science. And under this head, may be comprised a short account of such chemical substances, made in Scotland, as are afterwards employed in other arts and manufactures, or form a part of the compounds of the Materia Medica; and next, some notice shall be taken of the trades and occupations, or such mechanical arts as have not been fully described in the previous part of this chapter.

1. *Sulphuric Acid.*—This acid is termed, in common language, oil of vitriol, and is produced by the combustion of sulphur and nitre in close vessels lined with sheet lead. Its standard specific gravity is 1.850, or nearly double that of water; and it is sent to market in large glass bottles, contained in baskets of wicker-work.

It is more than half a century since *vitriol works* were erected in the west of Scotland; and those at present carrying on are situated near Glasgow,—at Woodside, St Rollocks, Napier's Hall, Port Dundas, and Carntyne. There are also several in the eastern districts, as at Burntisland in Fife, Prestonpans in East Lothian, Carriden parish in West Lothian, and Boroughmuir near Edinburgh. This acid is extensively used in the Scotch chemical manufactures, particularly in bleaching and calico-printing; and a considerable quantity is exported to Ireland.

The success attending the manufacture of this article has stimulated the proprietors to extend their researches to other branches of chemical science; and at present there are a greater number of intelligent *practical* chemists in Scotland, in proportion to the population, than perhaps in any other country in the world.

2. *Muriatic Acid.*—This acid is obtained from the decomposition of the muriate of soda, or common salt, by means of sulphuric acid, with which it is mixed in the retort, and distilled.

The first application of muriatic acid by bleachers, was for extracting iron mould from cloth; and the next was, for obtaining from it and manganese, the bleaching liquor; but in this process it is now superseded by sulphuric acid. It is, however, still used for clearing the gold ends of muslin goods; and by dyers and calico-printers, for a vast variety of purposes in their respective arts.

3. *Oxymuriatic Acid.*—This acid is produced from manganese, sulphuric acid, and sea salt, subjected to the process of distillation. Its most valuable property is its rapid action on vegetable substances, which it speedily whitens or bleaches. There were objections to the preparation and use of this acid in a liquid state; and it was combined with vegetable alkali. But as potashes were expensive, a cheap substitute was found in lime, which is now the material used for neutralizing the oxymuriatic acid,

This valuable discovery has rendered the art of bleaching both simple and easy; and to the manufacturers of linen and cotton the most important consequences have resulted, as they can whiten goods in a few hours which formerly required long exposure to the sun and air.

Mr Charles Tennent obtained a patent for this discovery; and he manufactures *bleaching salt*, as this article is denominated, to great extent, at St Rollock's, near Glasgow.

4. *Nitric Acid.*—This acid is known in commerce under the name of *aquafortis;* and is obtained by the distillation of sulphuric acid and nitre, or saltpetre. It is extensively employed in the arts, especially by dyers and calico-printers. It is not only used by itself, but, combined with the muriatic, it forms nitromuriatic acid, and termed *aqua regia*, from its power of dissolving gold; and by means of which, with tin, the beautiful scarlet colour is produced on woollens. In the various processes of etching on copper, nitric acid is a powerful agent, as well as in the gilding and frosting of metals.

5. *Fluoric Acid.*—This acid is obtained by the same process as muriatic acid, only substituting in the retort, which must be made of lead, fluor spar, instead of common salt. It has been applied in Glasgow to frost window glass used for cotton works.

6. *Pyroligneous*, or *Wood Acid.*—This acid is produced by the distillation of wood in a cast-iron retort. The gas passing through a worm contained in a refrigeratory, is condensed in the same manner as common spirits. The wood is left in a charred state in the retort, and may be used for any purpose to which charcoal is applicable. This acid is a powerful solvent of iron; and being only 4d. per gallon, is now almost universally used for making acetite of iron, or iron liquor; and acetite of alumine, a red liquor, for calico-printers and dyers. There are seven works for making pyroligneous acid in Scotland;—four at Camlachie, Tradestown, Brownfield, and Lanark, in Lanarkshire; one near Torryburn in Fifeshire; and two at Milburn and Cordale in Dumbartonshire. One ton of wood affords about 90 gallons of acid, and 10 gallons of tar. The latter comes over with the acid; but being heavier, readily subsides, and is separated.

7. *Prussiate of Potass.*—This article is manufactured to considerable extent at Campsie in Stirlingshire. It is produced from animal matter, as blood, hair, and hoofs of cattle, woollen rags, &c.; and the manufacture consists in mixing the substances with alkali, and calcining the composition until it resembles coal. Water is then added to dissolve the saline part, and the lixivium obtained is prussiate of potass. Either in this, or in the crystallized state, it is sold to calico-printers, who use it to produce a blue colour, which is as beautiful, though less durable, than that from indigo. *Prussian Blue* is also manufactured at the same work, to great perfection, and considerable extent; but it is used chiefly as a pigment.

8. *White Lead.*—This metallic oxyd is produced by exposing sheets of lead to the fumes of acetous acid; and the principal manufactory of it is established at Portobello, near Edinburgh. It is used, when mixed with oil, for painting ships, houses, and articles of wood and iron. Mills are employed for grinding the paint, which are driven by men or horses; and, in one instance, at Glasgow, by a steam power. Considerable quantities of white lead are ground with chalk and oil, and exported to the West Indies and America, for the purpose of painting. *Red Lead*, or the red oxyd of lead, is also made in Scotland; but the demand for it by painters is not considerable. It is used by white and brown potters, and also in the composition of flint glass, which it renders less difficult to cut or polish, and not so brittle as it would otherwise be. *Muriate of Lead*, or *Patent Yellow*, is made at only one place in Scotland, near Edinburgh. It is a composition of lead, and muriatic acid; but is now very little used.

9. *Acetite of Lead.*—This substance is known by the name of *Sugar of Lead;* and it is made at four manufactories in Scotland. At Rutherglen Bridge—the Cudbear work, near Glasgow—Airdrie, in Lanarkshire—and Linlithgow, in West Lothian.

ALKALIES. 1. *Kelp.*—The most important alkaline production of Scotland is *Kelp*, which is an impure soda, made in great abundance from various kinds of marine plants. The plants are found every where along the rocky shores of Scotland; but in the greatest profusion on the western coast, and the islands. They are cut, collected, dried, and burnt in rude kilns constructed for the purpose, (sometimes in cast-iron kilns, which is an improved mode), and the alkali is formed in large masses. This is the kelp of commerce, and in this state it is sold in the market.

The quantity of kelp annually made in the Hebrides, for these several years past, averages from 5000 to 5500 tons; in Argyleshire about 350; in Caithness 140; and, on all the other shores, including those of the Orkneys, upwards of 4000, making a total of about 10,000 tons. The number of people employed in this manufacture, during the kelp season, is not less than ten thousand; and, at many places, horses are used to carry the ware from the shore to the kiln.

This article is extensively used by the soap and glass manufactories; and the price varies according to circumstances. The expense of making it is regulated by the price of labour, and the difficulty of obtaining the plants. On the shores of the county of Inverness, for instance, it costs from 35s. to 50s. per ton; in the Hebrides, nearly 4*l.*; and in Ayrshire, from 4*l.* to 5*l.* 10s.; and, on the whole, the average may be estimated at about four pounds Sterling.

The price of kelp in the market fluctuates according to the demand; but the quality is very different, and the best always obtains the highest price. That produced from Staffa, and some other places, and prepared with more than ordinary care, has been occasionally sold at 20*l.* per ton, while inferior kinds have scarcely brought 6*l.* Supposing the average price, therefore, to be 12*l.*, the annual produce will amount to 120,000*l.*; and, calculating the expense at one-third, 80,000*l.* will remain as the profit of this manufacture.

2. *Soda.*—This alkali is obtained from the ashes of several kinds of marine vegetables, and is extracted from Barilla and Kelp.

Soda was first made in Scotland at the village of Dalmuir, in Dumbartonshire, and afterwards at Rutherglen Bridge, Port Dundas, Camlachie and Govan, near Glasgow; and at Leith, Queensferry, Greenock, and at different places in Ayrshire; but many of the works have been given up in consequence of the failure of demand for this article.

Soda is used by Turkey-red dyers, and in washing clothes; and, lately, in making Soda Water. This salubrious beverage is made at Edinburgh, Glasgow, Greenock, and at several other parts. It is merely a solution of soda in water, strongly impregnated with carbonic acid gas; and is used as a substitute for the waters of Spa, Seltzaer, or Pyrmont.

3. *Muriat of Ammonia*, or *Sal-Ammoniac.*—This salt is made from animal substances, as bones, horns, hoofs, &c. and also from soot. Some years ago, there were several works for the manufacture of this article at Edinburgh and Glasgow; but the only one now carrying on to any extent in Scotland, is at Borrowstounness. This salt is used by dyers, and very extensively by workers in metal, particularly in the process of tinning cast-iron culinary utensils. The price of sal-ammoniac is at present about 9*l.* 10s. per cwt.

4. *Sulphat of Soda*, or *Glauber's Salt.*—This article is used in medicine; and is made at Edinburgh, Glasgow, and several other places, from the residuum in the retorts when muriatic acid is distilled.

5. *Epsom Salt* and *Magnesia.*—These articles are made at Saltcoats, and in the neighbourhood of Edinburgh, from that portion of the concentrated sea-water of the salt-pans which does not crystallize, and remains after the salt is withdrawn.

6. *Allum*, or *Sulphat of Alumine.*—The manufacture of this salt in Scotland, commenced in 1797, at the village of Hurlet, in Renfrewshire; and other works, on a more extensive scale, were established in 1808, at Campsie, in Stirlingshire, by the same company. At both these works, 100 persons are employed, who receive each from 2s. to 3s. 6d. per day of wages. From 7000 to 8000 tons of coals are used annually; and the produce is about

1000 tons of alum, which are sold at from 20*l.* to 25*l.* per ton. Part of the alum is sent to England, Ireland, America, and the West Indies, and the rest is consumed at home.

This salt, so applicable in many chemical purposes, is used to great extent in the leather, dying, and calico-printing manufactures; in candle and paper making; and for other useful purposes.

7. *Sulphat of Iron, Green Vitriol,* or *Copperas.*—There are four copperas works in Scotland—two at Hurlet, one at Campsie, and the other at Baldernock in Stirlingshire, which employ 20 men, and manufacture upwards of 1000 tons annually. The price of copperas is at present from 5*l.* to 5*l.* 10s. per ton. This substance is very generally used in the arts; but the chief consumption is by dyers, calico-printers, and curriers, for imparting black and dark colours.

8. *Cudbear,* named from Cuthbert, the person who began this manufacture in Glasgow, is still, so far, an extensive monopoly, no other being in Scotland. There is one in Liverpool; another was in London, but is given up; and it was attempted in Ireland, without success. Having been 40 or 50 years in existence here, it may excite surprise that the secret of making this article should have remained so long undivulged.

It is a dye-stuff used in different ways for vegetable, but principally for the animal substances, wool and silk. To these it communicates very permanent purple, lilac, and various other shades, in which the red and blue colours are combined.

The chief, probably the only, materials used in its manufacture, are human urine and archil, a species of moss or lichen, collected in the Highlands of Scotland, and Norway; and latterly from several of the Canary Islands, and Malta.

By distillation, the ammonia of this fluid is driven off, and when united with water, forms liquid ammonia, which is used for sprinkling the moss in the process of converting it into Cudbear.

The buildings and machinery, principally pumping apparatus, are pretty extensive. A dozen or two of hands are employed performing various parts of the operations, of the nature of which, they are doubtless in a great measure ignorant. Others, with a few horses, collect the urine about the suburbs, and the collectors are furnished with pocket hydrometers, to prevent their being imposed upon by a spurious or inferior article. Large quantities of cudbear are sent to the West of England, and to the European and American Continents.

9. *Cream of Tartar* is refined at the above work, and at Rutherglen Bridge, near Glasgow. This is used in dying and medicine. It is imported in a crude state. At the Cudbear work, *Rochelle Salts* are likewise prepared.

1. *Coal-tar.* This (patent) manufacture was in 1787 introduced into Scotland, by the Earl of Dundonald, a nobleman much attached to chemical pursuits.

This mineral tar, it has been said, possesses some advantages over the vegetable tar in common use, for coating the bottoms of ships; because it is a sure defence against those marine animals, which in hot climates perforate the planks and timbers of vessels not sheathed with copper.

This manufacture was first established at Enterkin, but afterwards removed to Muirkirk in Ayrshire, not far distant, where it is now prosecuted with considerable energy.

It is obtained in most abundance from particular kinds of unctuous coal, by slow combustion, in circular brick kilns, of which the sides have a great number of perforations for admission of small streams of air: These, however, are from time to time stopped up in course of the process, as found necessary. The smoke and vapour having ascended the chimney, before escaping, have to go a great way horizontally, backward and forward, in slightly inclined labyrinthal passages, in which are numbers of projecting tiles, the whole intended to detain the aëriform fluids, and rob them as much as possible of the tar. Besides, the roof of these flues being covered with lead, and a sheet of cold water 16 inches deep, the condensation is rendered very complete; and accordingly, the tar, by its gravity, finds its way, in small streams, down channels prepared for its conveyance to receiving pits dug for the purpose; whence it is taken and put into barrels for sale.

When the tar has all come over, the holes in the kiln are closed. When cold, the coals, in a state of good coke, more valuable than when they were put in, are withdrawn, and sent off to the adjoining iron-works, to be used in smelting.—Before the tar is sold, it is most commonly boiled down to a very thick consistency.

There are forty-five of these kilns at present going; and each on an average is charged from ninety to a hundred times annually. The whole produce is about 360 tons of tar, or one ton per day; and it is sold at from 12s. to 14s. per cwt. The price is regulated by that of foreign tar, the former being always a few shillings per cwt. lower

It is used, at some works, as a black pigment for both cast-iron goods and smith-work, laid on with a brush when the metal is a little hot, to cause it dry soon.

2. *Lamp Black.*—There are considerable quantities of coal tar converted, at Muirkirk, into this substance, by means of combustion. The process is conducted much in the same manner as at the works where lamp black is made from foreign pitch; only, here, *no cloth* is used for this soot to settle on, as it collects upon,

and is scraped from, *the walls* of the houses built for that purpose. This black is used for almost all the purposes for which the common lamp black is employed; but, being a little coarser, it is sold somewhat cheaper.

3. *Coal Tar Oil* is produced by distillation. The tar, as it comes from the kilns, being put into a cast-iron retort, and heat applied, the vapour rising is condensed in a common worm contained in a refrigeratory. What remains, after the oil, &c. comes over, is very thick; and then answers most purposes better than before it underwent this process.

This oil is of a dark amber colour, and very volatile; its specific gravity is usually tried by the graduated hydrometric glass beads used for ascertaining the strength of spirits. Proof rum sinks bead 28; spirits of turpentine 22 or 23; and coal tar oil only 18 or 20.

At a work in Glasgow it is used, together with coal tar and ochre, in making a cheap brown paint, which is sold for 3s. the gallon.

At Muirkirk, the hands employed at the tar, the tar oil, and the lamp black making, amount to about twenty.

4. *Wood Tar* is obtained while distilling pyroligneous acid, already mentioned, in the proportion of about ten gallons for every ton of wood submitted to that process.

This substance not being quite water proof, has not yet been applied to any particular purpose, farther than coating course out-door wood work; for which even, from the above cause, it is not very applicable. At some of the manufactories where produced, large accumulations of it are kept, in expectation of one day being able to find an economical purpose to which it may be applied.

At a recently established chemical work in Glasgow, the only one of the kind in Scotland, and belonging to the same company who make the coal tar at Muirkirk, the following articles are manufactured; for which, and other purposes, a steam-engine of 24 horses' power is on the premises, together with from a dozen to twenty hands.

1. *Ivory Black.*—Produced from animal bones put into covered cast-iron crucibles, and exposed to violent heat in a kiln, so as to produce incineration;—they are afterwards pulverized between rollers and grindstones. The bones are collected in the city and suburbs, and cost the manufacturer from a guinea and a half to forty shillings per ton. Ivory Black, which is chiefly used by painters, is troublesome to manufacture pure, as the enamel of the teeth, when any happens to be ground along with the bones, produces a lighter colour, and consequently deteriorates the quality of the article. Considerable circumspection is also

necessary in the calcination, so as to produce what is called a good colour. It is sold here at about 12s. or 14s. per cwt.

2. *Blue Black.*—Made chiefly of ivory black; the other components are kept secret. It is used for water-colour painting on walls; and, along with chalk, forms a grey.—It is sold at 20s. per cwt.

3. *Francfort Black.*—Scraps and sawings of ivory, obtained from the comb-makers, and calcined, enter into the composition of this black; the other ingredient are also kept secret. It is used for copperplate printing on paper.—Its price is 80s. per cwt.

4. *Copperplate Printers' Ink.*—Prepared from Franckfort black, and other materials.

5. *Mineral Brown.*—Consists of an ochreous earth imported from Bristol, and well ground with coal-tar oil, and coal tar. This forms a cheap and good pigment for most purposes, particularly out-door work. It is of a dark mahogany colour, and is sold at 23s. 4d. per cwt.

The following articles of manufacture merit also to be noticed.

1. *Black Lead Powder.*—From that mineral (plumbago) got from Cumberland, &c. It is employed in the composition of crucibles (for brass, copper, &c.), of which there has lately been established a manufactory at Strathbungo near Glasgow. These vessels were formerly got from England.

2. *Yeast*, from malt, for bakers, is made at the Cudbear work, and Rutherglen-bridge near Glasgow; and thence sent to great distances, in small stout casks, having the bung kept in its place by an iron strap across it.

3. *Common Glue* is prepared at many of the large towns, where abundance of animal gelatinous substances can be cheaply procured. Besides which, importations of them in a dried state, called Scrows (Scrolls), are frequently made from Ireland. The buffalo skins which cover those packages, called seroons of cotton, have recently been employed in making a weak glutinous liquid, used by muslin weavers and winders, in sizing their yarn; and, for some kinds, is found to be very economical and advantageous.

4. *Gunpowder.*—There are very few works here for the manufacture of this dangerous commodity. The first erected was at Temple in Mid-Lothian, some years ago. Since then, two or three more have followed, mostly in the same quarter.

There are also prepared, in different parts of Scotland, oils, essences, and waters of peppermint, aniseed, pennyroyal, lavender, rosemary, cinnamon, &c. spirits of hartshorn, and a great variety of other minor articles in medical chemistry; also varnishes of different kinds, refined oils, blacking, &c.

CHAP. XVI. APP. No. 3.

GENERAL ABSTRACT *of the* **QUANTITY** *and* **ESTIMATED VALUE** *of* **LINEN CLOTH** *stamped for Sale in* **SCOTLAND**, *from the Year ending* 1st *November* 1728, *to the Year ending* 1st *November* 1812, *both inclusive.*

Years.		Total Yards.		Total Value.		
1728	- -	2,183,978	-	L.103,312	9	3
1729	Under 9d.	3,225,155¾	-	114,383	19	8½
1730	Ditto	3,755,622¼	-	131,262	15	11¾
1731	Ditto	3,891,573	-	145,656	14	3
1732	Above 9d.	4,384,832¼	-	168,322	14	10½
1733	- -	4,720,105⅛	-	182,766	2	1¼
1734	Above 9d.	4,893,499	-	185,224	3	11
1735	Under 9d.	4,880,633½	-	177,466	3	9¾
1736	Ditto	4,538,478½	-	168,177	13	0¾
1737	- -	4,721,420¾	-	183,620	13	9½
1738	- -	4,666,011½	-	185.026	11	9½
1739	- -	4,801,537½	-	196,068	16	11¾
1740	- -	4,609,672¾	-	188,777	16	5½
1741	- -	4,858,190¾	-	187,658	15	3½
1742	- -	4,431,450¼	-	191,689	6	6¾
1743	- -	5,061,311	-	215,927	6	7½
1744	- -	5,480,727	-	229,364	12	3¾
1745	- -	5,536,925¾	-	224,252	8	0¼
1746	- -	5,486,334	-	222,870	13	2¼
1747	Above 9d.	6,661,788½	-	262,866	10	2½
1748	- -	7,353,098	-	293,864	12	11½
1749	- -	7,360,286½	-	322,045	8	9½
1750	- -	7,572,540¼	-	361,736	12	5¾
1751	- -	7,886,374¾	-	367,167	11	6
1752	- -	8,759,943¼	-	409.047	6	7½
1753	- -	9,422,593¾	-	445,321	18	1¼
1754	- -	8,914,369	-	406,816	8	0½
1755	- -	8,122,472¼	-	345,349	14	6
1756	- -	8,547,153½	-	367,721	10	10¾
1757	Above 9d.	9,764,408¾	-	401,511	9	9½
1758	- -	10,624,435½	-	424,141	10	7¼
1759	- -	10,830,707	-	451,390	17	3
1760	- -	11,747,728¾	-	523,153	10	5
1761	- -	11,995,497¾	-	516,354	5	10¼
1762	- -	11,303,237	-	474,807	13	5½
1763	- -	12,399,656½	-	552,281	9	2
1764	- -	12,823,048¼	-	573,243	12	7¼
1765	- -	12,746,659½	-	579,227	11	3
1766	- -	13,242,557	-	637,346	11	2

Years.		Total Yards.		Total Value.		
1767	- -	12,783,043	-	633,854	2	1
1768	Above 1s.	11,795,437	-	599,669	4	2
1769	Ditto	13,406,125	-	689,790	16	2
1770	- -	13,049,535	-	634,411	7	1½
1771	- -	13,672,548½	-	632,389	8	5¼
1772	- -	13,089,006½	-	579,833	7	5¾
1773	Above 9d.	10,748,110½	-	462,751	0	11½
1774	- -	11,422,115	-	492,055	13	8½
1775	- -	12,134,683¼	-	561,527	10	2¾
1776	Above 1s.	13,571,948½	-	638,873	9	8
1777	- -	14,793,888½	-	710,633	18	7½
1778	- -	13,264,410¾	-	592,023	5	4½
1779	- -	12,867,238	-	551,148	3	3½
1780	- -	13,410,934¼	-	622,187	16	4½
1781	- -	15,177,800¼	-	738,482	13	11½
1782	- -	15,348,744½	-	775,098	7	5¼
1783	- -	17,074,777¾	-	866,983	10	6
1784	- -	19,138,593	-	932,617	1	11½
1785	- -	17,275,075½	-	835,081	14	3½
1786	- -	17,505,375¾	-	823,447	13	1¼
1787	- -	19,425,031½	-	843,920	13	5¾
1788	Above 1s.	20,506,311¼	-	854,870	16	3
1789	Ditto	20,000,195½	-	779,939	16	0¾
1790	Ditto	18,328,257¾	-	729,748	16	5¼
1791	Ditto	18,739,725¼	-	755,546	7	8
1792	- -	21,065,386	-	842,543	14	2½
1793	Under 9d.	20,676,620½	-	757,332	0	0¼
1794	- -	20,535,633¼	-	797,416	19	4
1795	Above 1s.	21,374,196	-	827,003	13	3
1796	- -	23,102,404½	-	906,202	8	4
1797	Above 1s.	19,475,241¼	-	735,084	4	0¾
1798	- -	21,297,059¼	-	850,403	9	9½
1799	- -	24,506,007	-	1,116,022	4	7
1800	Above 1s.	24,235,633½	-	1,047,598	10	10
1801	- -	25,271,870¼	-	1,018,642	8	0½
1802	- -	23,803,255	-	915,103	17	9¾
1803	- -	15,890,878½	-	687,692	4	6¼
1804	- -	15,198,676	-	749,115	13	4½
1805	- -	19,413,057	-	936,453	6	8¾
1806	Above 1s.	21,490,123½	-	973,171	2	8¼
1807	- -	20,776,774	-	957,238	16	0
1808	- -	19,390,497	-	1,014,629	18	4
1809	- -	22,469,990	-	1,171,880	8	10
1810	- -	26,457,079¾	-	1,265,669	17	2
1811	- -	21,499,765¼	-	999,439	4	5
1812	- -	18,975,862½	-	1,020,493	11	2¾

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	Weekly. L.	s.	d.	Yearly. L.	s.	d.
To Raw Wool, 3471 lib. per week, or 180,492 lib. per year, at 2s.	347	2	0	18,049	4	0
To Wages, of foreman, spinning-master, carding-master, picking-master, and their assistants, of 34 spinners, 102 piecers, 58 pickers and attenders on the fanning apparatus for cleaning the cotton, 46 carders, 50 reelers, or winders, stretchers, extra hands, and others, in all about 300, for picking, carding, roving, spinning and reeling, viz. 1s. per pound on the *neat* weight of yarn produced, being 2777 lib. (a fifth part of the gross weight of wool, or 694 lib. being allowed for indrink, waste and loss)	138	17	0	7,220	4	0
To Dross for the engine, 14 tons, at 5s. L.3 10 0 To Wages of an engine man . . 1 0 0 To Utensils, 12½ per cent. on 1600*l*., being the cost of the engine, &c. for tear and wear, upholding grease, oil, hemp, iron, brass, boilers, engine-house, &c. 3 16 11 To Interest, 5 per cent. on 1600*l*. paid for the engine . . . . . 1 10 9 N. B. This is about 10s. per week for each horse power, or for 20 .	9	17	8	513	18	8
To Utensils, for average of 10 per cent. on 25,000*l*. being the cost of the cotton machinery and building, for work and materials to keep the whole in repair, light, heat, and insurance against fire	48	1	6	2,500	0	0
To Incidents, for clerk's salary, porter's wages, stationery, postages, &c.	11	9	0	595	9	0
To Interest, 5 per cent. on 25,000*l*. paid for the mill and cotton machinery	24	0	9	1,250	0	0
To ditto ditto, on 5000*l*. of floating capital .	4	16	2	250	0	0
To Commission and risk of debts, 5 per cent. on amount of sales, as under	32	0	3	1,664	13	0
To Profit and Loss gained, exclusive of interest on sunk stock	24	0	10	1,250	0	0
Produce about 33s. 3d. per spindle, per annum L.	640	5	2	33,293	8	8
By Yarn, weekly produce, 168 millions of yards, or nearly 100 thousand miles—200 thousand hanks —11,108 spindles—2,777 lib.—or, annually, 144,404 lib. The value of this, at three farthings per hank, or 4s. 6d. per lib., which is very low, amounts to	624	16	6	32,490	18	0
By Waste, viz. of the 694 lib. allowed above, there may be one-third, or 231 lib. totally lost by indrink, sand, seeds, &c.—the remaining two-thirds sell for spinning into coarse yarns for calicoes, counterpanes, candlewicks, &c. at an average of 8d. per lib.	15	8	8	802	10	8
	L. 640	5	2	33,293	8	8

The profit here supposed to be made, is merely an assumption.' In establishments of this kind, it varies much. The amount of the whole transactions exceeding sixty thousand pounds Sterling; a small rise or fall in the market, either on the raw or finished material; the judgment, propriety, and economy exercised in the various departments; the good construction and order of the machinery, as well as other contingent circumstances, will have considerable effect in producing either loss or gain. A wheel, and supply of water for it, equal to twenty horses' power, will, in many situations, cost much less than a steam-engine; but, if thirty miles of land-carriage is incurred, to transport nearly two tons of wool from market, and return as much yarn weekly, the expense of men and horses, and other incidental charges, arising partly from local distance, the difference will not be so much in favour of the water-wheel, as at first sight it may appear. The difficulty of procuring lodgings, and feeding work-people in remote situations, is further to be added to the amount, independent of the capital sunk in buildings; although, on the other hand, something additional may be put in the scale, for the advantages resulting to the employer from his work-people living in a rural district, where most waterfalls are, and secluded from temptations, of various sorts, to which a town life subjects them.

Additional Particulars regarding the Cotton Manufactures of Scotland.

In the sketch that has been given of the cotton spinning of Scotland, almost all that is necessary to state, on the comparison of water and steam, as artificial moving powers in that country, has been done. Indeed the remarks will apply, with nearly equal force, to the seats of this and most other manufactures in England. Abundance of fuel has now fixed them in Yorkshire, Lancashire, Cheshire, Staffordshire. Warwickshire, &c.; and the cataracts of Cumberland, Wales, Cornwall, and Derbyshire, are little regarded.

From the preparation of cotton wool, until it arrives at the state of yarn, we now proceed to its fabrication into cloth.

Previous to the invention of the spinning machinery, no attempt was made to employ cotton yarn into any thing but wefts. When this invention had acquired that degree of practical maturity, as to produce cotton-twist, of sufficient strength to endure the fatigue of weaving, as warps; cloths for printing, wholly of cotton, began to be woven at Blackburn in Lancashire. This was about the year 1772; and, not long afterwards, a similar manufacture was successfully attempted in Scotland. These cloths received the Indian appellation of Calicoes.

As the quality and fineness of cotton-twist for warps were improved, almost every variety of cloth manufactured in the extensive districts of Hindostan, were successfully imitated; and the Indian appellations, which distinguish the various fabrics and qualities, generally retained.

The cotton manufacture having been introduced into Lancashire and Scotland nearly at the same time, the progress of improvement in each country, might have generated a greater competition than actually took place, had not a circumstance, partly accidental, and partly to be accounted for from previously acquired habits, led the two countries to adopt different fabrics, as the objects of their skill and industry.

The English weavers, formerly accustomed to imitate the denser fabrics of the Continent of Europe, attached themselves peculiarly to the manufacture of similar articles, merely substituting cotton as the raw material. Hence, to calicoes, succeeded jeans, fustians, thicksets, corduroys, cambrics, shirtings, &c. And their only imitations of the Indian manufacture, besides calicoes, were confined to pullicates, ginghams, nankeens, cossaes, and heavy jaconets.

But, previously to the introduction of the cotton manufacture in any shape, most of the lighter fabrics of France and Italy had been imitated and extensively manufactured in the west of Scotland; * (French yarn for that purpose being imported, as that spun here was found improper, chiefly from the inferiority of the flax.) Clear lawns, of considerable beauty and fineness, were made at Glasgow; and all the fanciful species of nets, and other light goods, at Paisley, first from linen, and afterwards from silk. Hence the Scottish weavers, accustomed to handle fine and delicate yarns, were led to imitate, in cotton, the lightest of the Indian fabrics, and the lightest texture of jaconets. Mull-mulls, and Buke, or Book muslins, were soon executed very perfectly; to which have been added, common spots, brocades, lappets of all sorts, imitation shawls, plain and linoe gauzes; spidered. seeded, and numerous species of drawloom and other work, of the most fanciful, delicate, and ornamental kinds; many of which, and the curious mechanism whereby they are executed, are exclusively Scottish invention. Besides these, immense quantities have been manufactured of cambrics, cossaes, shirtings, sheetings, tweels, stripes, checks, pullicates of Madras, French and common patterns, plain, tweeled, and diced—with ginghams, shawls, and other goods. Indeed, the general uses to which cotton fabrics of every description are applicable, and the accommodating and pliant nature of the substance itself, have operated much in favour of improvements, as well in the weaving as in the other branches of that manufacture. Of these improvements, we ought to have mentioned what was amongst the first and greatest, namely, the Fly-shuttle. Before its introduction, the weaver pitched his shuttle from one hand to the o-

* See the Section on Linen.

ther, being obliged to catch hold of it every time it went through the web. This was both tedious and laborious, especially in broad work. Now, however, he seldom has occasion to touch, except in filling it, as the boxes fixed at the end of his *lay* alternately receive it every shot; and it is discharged therefrom to the box opposite by a *driver*, to which motion is communicated from the weaver's hand, by means of a string. In weaving chequered goods, there is one or more extra boxes, which, by simple mechanical contrivances, shift and shoot different shuttles, containing, respectively, such kinds of weft as the pattern may happen to require.

Another source of employment arose, here, from a successful imitation of the Needle-work of the Continent, in the introduction and most rapid extension of the Flowering and Tambour work of Flanders. The art was originally acquired by females of superior rank, as a polite and elegant branch of domestic industry, and many years practised as an amusement. This circumstance afforded much facility of instruction; and the low price of female labour did still more. In this way a very great manufacture was quickly established, and flourished beyond every possible expectation which the most sanguine mind could have indulged, until checked by causes, partly common to the general manufactures of the country, and partly peculiar to itself.

The Tambouring, although still carried on to considerable extent, has a good deal given place to Hand-sewing, of almost every description that fanciful ingenuity can devise, or female fingers execute: as satin, chain, rope, seed, bead, button, open, and a variety of other stitches, performed with coloured and white cotton, linen and silk; also with coloured worsteds, gold and silver thread, spangles, &c. About twelve years ago, a successful attempt was made in Glasgow to tambour muslin by machinery, for which the inventor obtained a patent. A work was then established, and has continued ever since. There are at present in it sixteen frames, all going. Twelve of them, having each fifty-four needles, one inch asunder, are for 6-4ths muslin; the other four, having each one hundred needles, three-fourths of an inch asunder, are for 8-4ths muslin, or two webs of 4-4ths.

The whole are wrought by power from a steam-engine, and attended by sixteen females, one to every frame. One frame does as much work in a given time, as from fourteen to eighteen girls can accomplish by hand.

The machinery, as may well be conceived, is very complex, although not more so than a stocking-frame, to which it bears a considerable resemblance.

The muslin does not require to be printed before it is tamboured, as the form of the flower or ornament depends on the indentations of two eccentric wheels, that guide the progress of the frame in which the cloth is vertically stretched, the needles remaining relatively stationary, but moving on their own axis, as well as horizontally, backward and forward, for the perforation of the cloth at every stitch. The power required to work the sixteen frames, is considerably less than that of two horses.

The nature of the muslin trade of Scotland, was, for many years, peculiarly unfavourable to the prosecution of every species of thick goods. The extensive external demand, and high prices obtained for every kind of light, fanciful articles, afforded great scope to inventive genius, and diverted the whole attention of both master and operative weavers, from almost every substantial fabric, excepting the finer sorts of cambrics, shirtings, and pullicates. Hence, it became, at one period, a matter bordering on impossibility, to procure hands for any of the most common, although infinitely most useful kinds of cotton cloth. Besides, the rise upon provisions, and every other necessary of life, occasioned by the increase of public burdens, had rendered the highest prices that could be given for weaving coarse cottons, to stand competition with India goods, quite inadequate for the support of the weaver and his family; and consequently, he would not work at them, so long as he could get finer, for which he was better paid.

The calico-printers, in particular, found it impracticable to procure the low-priced articles, which form by far the greatest branch of their trade, either in sufficient abundance, or at reasonable rates. Necessity therefore prompted, as a remedy for scarcity of hands, the substitution of machinery for manual labour.

The operations required in a loom for weaving plain cloth, are very far from being either complicated or difficult. Hence the wonder seems to be, not that power or automatic looms were, but that they were not sooner erected, and much more rapidly matured than the best of them are, even at this moment. The first attempts in Scotland, were made at Milntown printfield, in Dumbartonshire, at least it was there where they first assumed the appearance of regular and extensive business:—nearly about the same time, they were introduced at Stockport in England. It is foreign from the present design to investigate mechanically the difference of the power looms adopted there and here:—each of them possesses merits exclusively their own, and both seem still susceptible of improvements. Defective, however, as the mechanical part still unquestionably is, the chemical part is infinitely more so. Many modes of dressing the warps have been tried, but without very flattering success; nor will this be remedied, until Chemistry comes to aid her sister science. It is in the composition of the dressing mucilage, not in its mechanical application to the yarn, that the deficiency still exists. There is a third species of Power loom, which was constructed by an Englishman, and brought into use in Glasgow, under a patent. In the other looms, the cloth is stretched horizontally; in this it is done vertically. The patent loom possesses some advantages in point of form; the small compass in which it stands; and a few other peculiarities, that certainly render it of some consequence, as a mechanical improvement in Power weaving:—it has been used in the linen and woollen, as well as in the cotton manufacture.

Of the power looms recently made, the frame, and many of the other parts, are constructed of cast iron, which is both ultimately cheaper, and is found to answer almost every purpose much better, and to last longer than wood: and although only coarse goods can as yet be woven on them, yet there is every reason to expect that finer may in time, when farther improvements are made:—but they will never altogether supplant the weaving of superior fabrics in the usual way.

At Catrine, in Ayrshire, there are 234, on many of which, excellent tweeled cottons for sheeting and other similar purposes are wove; but, in general, the power looms are employed on plain cotton cloths for printing—27 or 30 inches wide—in a 9, 10, or 11 hundred reed; that is, the reed containing respectively 900, 1000, or 1100 splits in the space of 37 inches—2 threads working in each split. Of these cloths, one loom produces, weekly, from three to four pieces of twenty-eight yards each; some of the coarsest of which, have lately, during the stagnation of the cotton trade, been sold in a bleached state at 13s. 6d. each; a price extremely low, when we consider the immense capital sunk in the machinery, for the various stages of manufacture through which they pass.

In some places a girl superintends the working of one, in others, two of these looms. Ten or twelve of them can be driven by one horse's power, the expense of which has already been calculated; so that the comparative advantage of this mode of weaving should be considerable; though the exact ratio of it will depend much on the prices paying at the time, for such work done by hand, as well as on other contingencies, which, in an infant branch of manufacture, cannot be either exactly foreseen or calculated. In general, however, the difference is somewhere about 20 per cent. in the amount of weaving, and from 6 to 10 per cent. on the value of the goods; besides the certainty with which the manufacturer can count on forwarding his article in a given time. As a drawback, however, on these advantages, the power-loom manufacturer, in bad times, cannot easily get rid of his machinery; and if not employed, it soon gets out of repair; whereas those who employ hand-weavers only, can drop them whenever their webs are finished. There are just now, several large factories in Lanarkshire, &c. fitting up for the reception of about 500 power-looms, which are preparing; besides 1560 mostly at work, and principally at Milnton in Dumbartonshire, Deanston in Stirlingshire, Catrine in Ayrshire; Pollockshaws, Paisley; Johnston, Thornly-bank; Busby and Fareneze in Renfrewshire; Anderston, Tradestown, Hutchisontown, Calton, Gorbals, and Blantyre near Glasgow, in Lanarkshire: so that this branch of the cotton trade is likely soon to become very important; and although looked upon with a jealous eye by the workmen of that class, yet, in a political point of view, this mode of fabricating cloth is more advantageous to the community, and, in many cases, will be so even to these men; for, in a country like Scotland, possessing, as she does, so limited a male population, by employing artificial, instead of muscular power, a great number of able men, will be taken from the sedentary and penurious occupation of the loom, to others more healthy and beneficial, while their place will be filled up by the other sex, who are constitutionally better fitted for it, and of whom, owing to the unnatural situation of the country, there are, and long has been, a very great redundancy.

In weaving by power, the machine was frequently obliged to be stopped, until the yarn underwent the process of dressing: this occurred almost every yard, and lost much time: it was, besides, found more inconvenient, from the projecting parts of the machinery, and other causes, to dress the yarn in the power-loom, than in the common. To avoid *dressing in the loom at all*, became therefore a great desideratum.—Hence dressing machines were constructed.

Dressing in the common way, is performed with two brushes, a foot or eighteen inches long each, with which the weaver works the flour-dressing, or other mixture upon the yarn, for smoothing its surface, to facilitate the operation of weaving. Its drying is then accelerated, either with a hand-fan, a piece of hot iron, embers, or other contrivance to save time, particularly if the weather be damp, and the warp heavy.

In the dressing machine there are two cylinders, as long as the web is broad: the surface of each of these is covered with bristles, forming a brush. These cylindrical brushes being furnished with dressing material, in revolving dress the warp, which is made to pass slowly along the surface of the brushes, and is dried *in transitu*, by one or more revolving fanners, driven by the same power that moves the brushes and other parts of the apparatus. This power may be either muscular or artificial.

There have several kinds of Dressing-machines been invented, one of which in Scotland is under patent; but the principle of them all is nearly alike. With the assistance of a man or two, one machine can dress several webs in a day; and, if well done, the power-loom can work them without intermission, except being occasionally stopped for replenishing the shuttle with weft, repairing broken yarn and other contingencies. But the dressing machine has as yet made very little progress, there not being above a score in Scotland, and these for power-looms only; some of which are now working coarse cottons, without any dressing at all, particular care being taken in properly *sizing* the warp, before it is put into the loom.

Attempts have been made to warp and dress the web at the same time; but have not been so successful as was wished. Indeed, the process of Warping seems to remain pretty nearly stationary. It has not been thought necessary to ascertain the number of warping-mills for cotton in Scotland, as there are always more than what are regularly employed; but, when it is known that the cotton weavers amount to upwards of 50,000, and that one mill will on an average warp for 90 weavers, the total warpers will run about 555.

The Winding-machine is a very recent improvement in the cotton trade. They are sometimes driven by foot, and sometimes by artificial power. They contain from 20 to 144 spindles each. One female can attend from 36 to 48 spindles—on every one of which, there is a bobin, which winds the yarn from the cope, preparatory to being warped. The cope consists of the yarn coiled up in a conical form, as it comes from the spindle of the mule:—some of the winding machines are constructed so as to wind hank yarn. The whole of them have generally a long cylindrical roller, of 3 or 4 inches diameter, which revolve in a trough filled with weak mucilage. Upon this roller, the yarn, in passing to the bobins, receives a partial sizing. In a large manufactory, the advantage of this mode of winding is very great; for, besides saving of room, one girl, when employed on copes, can, in some cases, do as much work as a dozen on the common wheel of one spindle.

Several efforts have been made to introduce the winding-machine on a smaller scale amongst weavers, for filling their quills or pirns in this speedy manner. A few of these were constructed, which answered the purpose pretty well, when properly used: But having been put into the hands of females, perhaps prejudiced against them, and little acquainted with mechanical operations of that nature, and the cost of the machine amounting to several pounds, they did not succeed.

About a dozen of years ago, a laudable and ingenious attempt was made in Glasgow, to avoid the process of quill-winding altogether, by fixing the cope, as it came from the spinner, into the shuttle, instead of a pirn; and to avoid the inconvenience arising from the incommodious size of the cope, a machine was invented (under patent) for compressing it into small bulk, to answer the size of the shuttle: But this scheme, though it promised fair in some cases, never became general, and has long ago fallen asleep.

Of the manufacture of cotton hosiery in Scotland, Glasgow is the chief seat; though, as was noticed above, the twist of which they are made, is almost altogether obtained from England; where, particularly in Nottinghamshire, this branch of the trade, both in spinning and weaving, has taken deep root. The total number of stocking frames employed on cotton in Scotland does not exceed 2000; and the amount of goods manufactured is somewhere about 160,000*l.* per annum. The cotton weaver's weekly wages average about 18s. 6d. When the frame he works on is not his own, which is often the case, he has to allow about 1s. per week out of his wages for the use of it. The workmen are all paid by the piece, at so much for each dozen of pairs of stockings, &c. according to the gauge of the frame in which they are wrought.

The gauges run from 14, the coarsest—to 42, the finest;—and are calculated by the number of leads contained within the space of three inches, two needles being in each lead. Thus, in a 24 gauge frame, there are 16 needles in one inch.

Since water-twist was invented, much of it has been used here in the fabrication of tapes and other incle goods, either wholly of cotton, or mixed with linen or woollen.

Scotland, as already mentioned, has long been famous for her linen threads. Within these few years, a new species of that article has been introduced, which has succeeded far beyond expectation. It is composed of two, and often of three plies of cotton-yarn twined together; and, when the material is considered, its tenacity is wonderful: hence it has obtained the name of Wire Thread, and proved a formidable rival to thread made of linen, being both cheaper, and more evenly. Before the present war, large quantities were sent to America. It is still an article of considerable export to the West Indies and other parts, and generally pays the maker well. The twisting process is performed either on a jenny, fitted up for the purpose, on a throssil frame; or on the old Dutch thread-mill. It is then bleached or dyed, and sold either in hanks, or coiled up into neat balls or clues of different sizes. The balling machine is also a new invention, commonly driven by hand, and contains from 6 to 40 spindles; each of which have two motions, similar to two of those of the earth; one on its own axis, the other a diagonal or equatorial motion, but both very slow, round each spindle: But, independent thereof, a kind of metal finger revolves, similar to the heck of a lint-wheel; at the end of this finger is a hole, through which the head passes, and is laid with great accuracy and despatch on the spindle, in layers or wreaths, until the ball accumulates to the size wanted. The cotton thread-making and boiling is kept rather a secret work in Scotland. The total quantity made, per year, does not exceed 560,000 lib.; value about 196,000*l.* Sterling.

Connected with the Cotton manufacture, we may notice the mode of finishing the goods.

Some sorts of cotton goods, before being bleached, are subjected to the process of Singeing. The Singeing machine consists of two cylinders, with a handle on the end of each, and placed 8 or 10 feet asunder; the one is for receiving the cloth, while the other delivers it: and *vice versa*. Between the cylinders, is a furnace surmounted by a convex cast-iron plate, about 8 or 10 inches broad, and 6 or 8 feet long. The fire in the furnace brings the piece of metal up to a red heat:—the cloth is then wound from one cylinder to the other, and both sides of it passed on the surface of the heated plate. The consequence is, all the loose oozy fibres of the cotton are burnt off, and the cloth rendered quite bare and smooth. The trade of muslin singeing is carried on as a distinct branch:—the usual price is about a penny for each piece.

The Improved Calender, for glazing cloths of various kinds, was introduced at Glasgow some years ago, under letters patent. It can glaze about 100 pieces, of 28 yards, per day; and the work gives satisfaction to the exporting merchants, both from its quality, and the ease with which, in cases of emergency, they can complete their shipments. The operation consists in passing the cloth between a metal and a paper roller; one of which, revolving quicker than the other, the smooth surface of the former produces a fine gloss or polish on the surface of the cloth. Glazing, though perhaps less perfectly, is yet well performed by the common calender. These are generally driven by horses; though the one first mentioned, and a few others in Scotland, are driven by steam, and several by water. The common calender was formerly heated by pieces of hot iron thrust into their hollow metal cylinders or rollers. Of late years, steam has been successfully applied by many to that purpose, being conducted by pipes into the cylinders. Its heat can be increased above 212, the boiling point of water, by the simple contrivance of loading the safety valve of the boiler, in which the steam is generated. This heat is more regular, and less troublesome, than the other.

Another mode of giving cloth a very superior gloss, is performed by the friction of a piece of silicious stone, a few inches long, rubbed with much force and pressure on the surface of the cloth, which has previously been slightly waxed, in order the better to acquire a fine rich glaze:—this is chiefly done on printed callicoes; but the process is very tedious and laborious. A large and expensive machine, with numerous flints, to glaze in this manner, was made at Glasgow about seven years ago:—it was to have been driven by a horse or steam-engine; but could not be got to work, so as to answer the purpose intended. The same idea has, however, been again taken up; and a machine has recently been constructed, which is at present working in Glasgow, and performs well.

Some sorts of goods are glazed in the mangle; but this is not by any means general. The most approved gloss for fine cambrics and shirtings, is given by beetling. In the early stages of the trade, this was performed by muscular power—a man using a wooden mallet or beetle in each hand. But now the process is performed much better on the beetling machine, driven by a water-wheel or steam-engine. Several pieces of the cloth are wrapped round a horizontal cylinder; upon which, as it revolves on its axis, and longitudinally backwards and forwards, twelve or more beetles, at proper distances from each other, are alternately and rapidly raised, and let fall for half an hour or longer on the cloth, which by this means is much improved in look, having acquired a fine silky appearance.

After the goods are folded, they are subjected to pressure, more or less, according to circumstances. The presses most in use, are those with an iron screw, wrought by levers. Several of Bramah's aquatic presses have lately been introduced for this purpose, and given much satisfaction; but their number in Scotland does not exceed 10 or 12.

On the whole, the cotton trade, which may be said not to have existed above 40 years, has now become the greatest and most extensive of any in Scotland, annually producing about six millions Sterling, and employing in all its branches 150,000 persons, young and old. This, however, is not equal to what it may be expected this branch of industry will reach, at no very distant period.

NOTES *omitted in* SECTION *on* COTTON.

Imports of Cotton Wool into Clyde alone, at different periods, viz.

In 1775	-	508 bags, &c.		137,160 lib.
1790	-	6,509	—	1,757,504 ..
1810	-	38,614	—	9,962,359 ..
1811	-	42,749	—	11,002,723 ..
1812	-	43,080	—	11,114,640 ..

Imports of Cotton Wool into Liverpool, at different periods, viz.

		Bags, &c.			Bags, &c.
In 1791	-	68,404	In 1802	-	135,192
1792	-	72,364	1803	-	140,291
1793	-	24,971	1804	-	153,126
1794	-	38,022	1805	-	177,508
1795	-	54,841	1806	-	173,074
1796	-	63,526	1807	-	196,467
1797	-	58,258	1808	-	66,215
1798	-	66,934	1809	-	267,283
1799	-	89,784	1810	-	320,594
1800	-	92,580	1811	-	174,132
1801	-	98,752	1812	-	171,551

COTTON WOOL imported into Great Britain, viz.

		Lib.	
In 1786	-	19,475,020	
1787	-	23,250,263	
1788	-	20,467,436	
1789	-	32,576,023	
1790	-	31,547,605	
			25,463,269 lib. average for 5 years.

[*The above was published in* 1792.

The following OFFICIAL STATEMENT from the Custom-House was presented to the HOUSE OF COMMONS in June 1812, of the Importations during 20 years, viz.

COTTON WOOL Imported into Great Britain.

		Lib.		
In 1792	-	34,907,497		
1793	-	19,040,929		
1794	-	24,358,567		
1795	-	26,401,340		
1796	-	32,126,357		
			27,366,938 average for 5 years.	
1797	-	23,954,371		
1798	-	31,880,641		
1799	-	43,379,278		
1800	-	56,010,732		
1801	-	56,004,305		
			42,245,865	ditto
1802	-	60,345,600		
1803	-	53,812,284		
1804	-	61,367,329		
1805	-	59,682,406		
1806	-	58,176,283		
			58,676,780	ditto
1807	-	74,925,306		
1808	-	43,615,982		
1809	-	92,812,282		
1810	-	136,488,935		
1811	-	91,576,535		
			87,883,808	ditto

Cotton Wool imported into Great Britain.

		Bags.
In 1802	-	281,383
1803	-	238,898
1804	-	242,610
1805	-	252,620
1806	-	261,738
1807	-	282,667
1808	-	168,138
1809	-	440,382
1810	-	561,173
1811	-	326,231
1812	-	261,205

CHAP. XVI. APP. No. 5.

No. I.—An ACCOUNT of the NUMBER of VESSELS, their TONNAGE, NUMBER of MEN, &c. &c. from the Year 1801 inclusive, to the Year 1811 exclusive.

For the Year 1801, ending 5th January 1802.

Coasters. Inwards. No. of Vessels.	Coasters. Inwards. Tonnage.	No. of Men.	PORTS.	Coasters. Outwards. No. of Vessels.	Coasters. Outwards. Tonnage.	No. of Men.
747	49,635	3,064	Aberdeen - -	603	37,908	2,644
268	12,852	970	Banff - -	191	7,481	663
171	6,609	709	Ayr - -	196	7,236	727
308	10,159	1,031	Alloa - -	1,220	57,416	3,854
270	8,172	784	Anstruther -	230	8,160	744
698	40,643	2,739	Borrowstounness -	1,677	81,928	5,786
132	5,390	560	Caithness or Thurso	188	7,718	830
223	3,745	569	Campbelltown -	220	3,800	666
376	11,144	927	Dumfries -	237	9,287	670
282	13,309	925	Dunbar -	166	7,750	554
987	52,628	3,732	Dundee -	760	38,765	2,841
38	1,883	127	Fortwilliam -	18	846	55
388	19,418	1,213	Inverness -	394	10,481	996
121	5,042	449	Irvine - -	139	4,818	544
36	1,448	112	Islemartin -	50	1,394	114
422	16,385	1,399	Kirkaldy -	594	20,265	1,756
183	7,053	529	Kirkcudbright -	202	9,146	676
1927	116,575	4,481	Leith - -	1,192	70,269	4,593
796	34,265	2,778	Montrose -	317	13,874	1,101
223	7,805	764	Oban - -	271	6,914	887
56	2,770	270	Orkney or Kirkwall	71	3,715	374
740	32,737	2,578	Perth - -	374	15,589	1,295
157	7,936	584	Port-Glasgow -	140	7,461	532
600	23,748	1,771	Glasgow -	582	21,631	1,670
965	86,770	4,151	Greenock -	1,169	52,073	5,056
99	4,775	503	Prestonpans -	111	4,436	307
701	19,765	2,535	Rothsay -	354	10,512	1,830
29	1,536	142	Stornoway -	61	2,594	253
146	5,186	76	Stranraer - -	121	6,096	678
—	—	—	Portpatrick -	1	45	6
118	1,643	359	Tobermorray -	107	1,641	343
81	2,858	198	Wigtown -	151	5,721	383
34	2,050	149	Zetland or Lerwick	37	2,026	142
12,332	620,934	41,808		12,144	538,995	43,570

ACCOUNT—*continued.*

For the Year 1802, ending 5th January 1803.

Coasters. Inwards. No. of Vessels.	Tonnage.	No. of Men.	PORTS.	Coasters. Outwards. No. of Vessels.	Tonnage.	No. of Men.
808	54,172	3,368	Aberdeen - -	687	41,215	3,021
329	15,994	1,222	Banff - -	280	12,077	1,022
153	6,498	691	Ayr - -	213	7,347	839
469	2,579	1,686	Alloa - -	1,223	61,784	4,049
241	8,590	714	Anstruther -	242	9,107	752
743	43,427	2,691	Borrowstounness -	1,711	81,623	5,886
144	6,736	574	Caithness or Thurso	133	5,293	530
225	5,107	900	Campbelltown -	208	4,779	960
483	13,480	1,109	Dumfries -	271	10,818	771
222	10,670	693	Dunbar -	155	7,284	495
948	49,734	3,690	Dundee -	873	41,882	3,194
53	2,796	196	Fortwilliam -	26	1,496	101
881	22,190	1,451	Inverness -	206	12,412	783
127	4,872	533	Irvine - -	95	2,661	314
33	1,668	122	Islemartin -	31	1,448	109
330	12,981	1,090	Kirkaldy -	620	25,870	1,919
179	7,223	529	Kirkcudbright -	239	10,864	715
2,010	8,870	9,157	Leith - -	1,064	71,996	5,725
698	31,445	2,807	Montrose - -	333	14,783	1,162
181	5,801	653	Oban - -	229	5,450	833
53	3,001	162	Orkney or Kirkwall	66	4,452	359
839	36,367	2,874	Perth - -	438	18,836	1,355
172	6,496	401	Port-Glasgow -	154	8,687	541
674	27,377	2,087	Glasgow -	684	24,901	2,008
927	42,094	3,942	Greenock -	1,155	49,319	4,452
117	5,214	328	Prestonpans -	108	2,249	265
566	17,113	2,009	Rothsay - -	410	12,593	2,182
405	1,964	191	Stornoway -	45	1,792	181
157	6,235	645	Stranraer -	150	5,224	572
5	202	18	Portpatrick -	5	277	21
57	1,519	171	Tobermorray -	57	1,400	187
87	2,221	223	Wigtown -	160	6,904	410
61	3,375	213	Zetland or Lerwick	35	1,961	136
12,456	600,579	47,140		12,306	568,784	45,849

ACCOUNT—*continued.*

For the Year 1803, ending 5th January 1804.

Coasters Inwards.				Coasters Outwards.		
No. of Vessels.	Tonnage.	No. of Men.	PORTS.	No. of Vessels.	Tonnage.	No. of Men.
835	57,198	3,643	Aberdeen - -	645	35,681	2,904
306	15,679	1,085	Banff - -	262	10,093	865
201	7,136	816	Ayr - - -	200	6,195	707
440	25,560	1,589	Alloa - -	1,137	58,041	3,702
182	6,489	537	Anstruther -	213	7,964	658
556	36,092	2,181	Borrowstounness	1,532	72,557	4,918
131	5,968	504	Caithness or Thurso	101	4,887	283
265	7,726	926	Campbeltown -	200	5,968	702
396	13,211	1,039	Dumfries -	216	8,707	613
333	16,252	1,085	Dunbar - -	118	5,722	399
782	44,955	3,069	Dundee -	732	37,041	2,714
59	2,672	182	Fort-William -	29	1,657	98
399	22,151	1,455	Inverness - -	199	12,211	793
122	4,326	382	Irvine - -	124	2,875	338
46	2,010	138	Islemartin -	27	864	74
206	10,773	866	Kirkaldy - -	642	27,786	2,099
191	6,061	521	Kirkcudbright -	167	7,409	470
1,973	146,748	8,859	Leith - -	936	67,580	4,719
707	32,004	2,574	Montrose -	311	13,509	1,109
162	6,216	551	Oban - -	220	7,401	736
92	4,980	465	Orkney or Kirkwall	84	4,711	431
763	33,314	2,409	Perth - -	421	17,818	1,321
182	7,226	551	Port Glasgow -	120	7,202	424
652	26,003	1,876	Glasgow - -	704	26,291	1,945
730	34,532	3,147	Greenock -	1,016	43,909	3,326
155	6,532	478	Prestonpans -	120	5,043	378
539	14,771	1,808	Rothsay - -	455	9,936	1,367
56	2,533	220	Stornoway -	31	1,064	123
142	4,518	484	Stranraer - -	152	5,087	490
6	147	16	Port Patrick -	8	253	27
82	2,863	242	Tobermorray -	84	1,710	263
98	3,203	222	Wigtown -	150	5,944	384
70	4,056	269	Zetland or Lerwick	73	4,343	294
11,918	613,905	44,189		11,429	526,259	39,664

ACCOUNT—*continued.*

For the Year 1804, ending 5th January 1805.

Coasters Inwards.		No. of Men.	Ports.	Coasters Outwards.		No. of Men.
No. of Vessels.	Tonnage.			No. of Vessels.	Tonnage.	
722	52,438	3,475	Aberdeen - -	707	43,646	3,322
265	12,779	908	Banff - -	263	10,467	878
157	6,374	602	Ayr - -	207	5,587	658
475	27,350	1,646	Alloa - -	946	51,952	3,327
220	8,257	632	Anstruther -	237	8,898	721
646	39,025	2,792	Borrowstounness	2,120	98,530	7,097
96	4,962	362	Caithness or Thurso	95	4,509	356
197	5,705	811	Campbeltown -	253	7,291	967
359	11,021	901	Dumfries -	349	13,591	957
284	13,763	917	Dunbar - -	149	8,093	528
805	45,789	3,054	Dundee - -	816	41,357	2,857
68	2,720	201	Fort William -	96	3,336	298
399	22,636	1,438	Inverness - -	199	12,838	772
92	3,293	308	Irvine - -	83	1,988	851
38	1,297	134	Islemartin -	26	1,034	102
299	11,791	940	Kirkaldy - -	750	30,168	2,265
156	6,516	439	Kirkcudbright -	208	9,110	580
2,960	103,743	7,666	Leith - -	886	68,606	4,590
703	33,280	2,609	Montrose -	369	18,045	1,381
160	6,715	555	Oban - -	163	5,156	520
80	4,412	408	Orkney or Kirkwall	78	4,267	397
775	35,786	2,644	Perth - -	502	23,302	1,666
194	9,305	586	Port Glasgow -	115	7,548	437
745	29,847	2,047	Glasgow -	767	26,532	1,958
657	30,388	2,678	Greenock - -	829	34,255	2,850
169	6,782	505	Prestonpans -	93	3,874	259
542	14,744	1,784	Rothsay -	349	7,685	1,389
32	1,614	139	Stornoway -	35	1,164	139
115	3,405	320	Stranraer - -	156	4,919	419
12	418	35	Port Patrick -	8	272	23
70	2,395	206	Tobermorray -	67	1,528	199
106	3,875	266	Wigtown - -	177	7,077	560
46	1,947	191	Zetland or Lerwick	38	2,412	152
12,644	564,374	42,199		12,136	569,037	42,475

ACCOUNT—*continued.*

For the Year 1805, ending 5th January 1806.

Coasters Inwards. No. of Vessels.	Coasters Inwards. Tonnage.	No. of Men.	PORTS.	Coasters Outwards. No. of Vessels.	Coasters Outwards. Tonnage.	No. of Men.
855	60,666	3,859	Aberdeen - -	818	51,618	3,771
333	15,741	1,082	Banff - -	283	11,690	915
148	5,606	471	Ayr - -	219	5,116	561
520	26,519	1,625	Alloa - -	964	46,752	2,831
299	10,691	899	Anstruther -	245	9,380	712
682	42,294	2,788	Bo'ness and Inverkeithing	2,279	109,914	6,793
100	4,973	367	Caithness or Thurso	158	7,915	543
231	7,855	941	Campbeltown -	249	6,519	914
375	12,260	962	Dumfries - -	332	13,635	932
328	14,208	1,028	Dunbar - -	146	7,735	484
852	48,491	3,303	Dundee - -	852	44,506	3,114
80	3,667	263	Fort William -	91	4,318	294
336	19,254	1,252	Inverness - -	278	17,751	1,089
122	4,065	337	Irvine - -	125	2,790	330
32	1,418	123	Islemartin -	35	1,644	157
249	9,556	739	Kirkaldy - -	635	24,490	1,984
160	6,317	450	Kirkcudbright -	205	8,285	549
2,260	125,800	8,968	Leith - -	1,190	81,512	5,912
755	36,459	2,794	Montrose - -	396	18,484	1,449
195	6,722	594	Oban - -	215	6,021	650
59	3,009	268	Orkney or Kirkwall	77	4,124	357
786	36,744	2,535	Perth - -	459	20,252	1,418
222	10,177	673	Port Glasgow -	138	9,336	545
875	36,287	2,399	Glasgow - -	884	31,552	2,248
621	27,627	2,133	Greenock -	816	33,047	2,615
178	7,604	557	Prestonpans -	107	4,293	335
444	12,537	1,577	Rothsay - -	369	9,278	1,333
33	1,631	145	Stornoway -	35	1,247	131
123	3,959	361	Stranraer - -	145	3,591	370
7	333	28	Port Patrick -	3	157	15
80	1,869	215	Tobermorray -	114	1,900	289
108	4,150	286	Wigtown -	140	5,600	398
39	2,393	150	Zetland or Lerwick	37	2,283	140
12,487	6,100,882	44,192		13,039	606,735	44,173

ACCOUNT—*continued.*

For the Year 1806, ending 5th January 1807.

Coasters. Inwards. No. of Vessels.	Coasters. Inwards. Tonnage.	No. of Men.	PORTS.	Coasters. Outwards. No. of Vessels.	Coasters. Outwards. Tonnage.	No. of Men.
901	65,419	4,256	Aberdeen - -	830	54,780	3,990
316	16,137	1,044	Banff - -	252	10,873	802
182	6,192	559	Ayr - -	206	5,559	597
523	27,544	1,632	Alloa - -	1,033	49,374	3,115
303	11,191	810	Anstruther -	328	12,707	332
804	46,426	3,186	Bo'ness and Inverkeithing	2,257	105,942	7,374
137	7,466	513	Caithness or Thurso	168	7,993	611
215	7,282	864	Campbelltown -	203	6,177	789
390	14,312	1,044	Dumfries -	257	10,304	693
351	16,825	1,075	Dunbar -	158	6,706	427
785	45,321	3,048	Dundee -	775	41,540	2,986
78	3,797	257	Fort William -	109	5,296	352
413	24,665	1,542	Inverness - -	267	16,061	1,043
102	2,991	285	Irvine - -	116	2,426	300
34	1,387	123	Islemartin -	28	1,351	117
512	20,392	1,612	Kirkaldy -	819	33,841	2,700
167	5,940	443	Kirkcudbright -	182	7,155	517
2,264	136,552	9,838	Leith - -	1,070	81,728	5,830
778	36,869	2,837	Montrose -	490	22,247	1,744
161	6,134	529	Oban - -	166	5,157	536
63	3,184	278	Orkney or Kirkwall	78	3,992	364
828	39,368	2,800	Perth - -	538	25,731	1,804
182	9,273	587	Port-Glasgow -	152	10,163	603
878	38,477	2,579	Glasgow -	880	33,097	2,461
658	29,871	2,402	Greenock -	784	33,715	2,556
152	6,590	456	Prestonpans -	146	5,498	414
432	12,697	1,532	Rothsay -	340	11,058	1,565
46	2,104	205	Stornoway -	36	1,096	122
125	3,774	316	Stranraer - -	180	5,484	422
5	253	20	Portpatrick -	4	139	13
101	3,607	257	Wigtown -	153	6,347	442
46	2,812	165	Zetland or Lerwick	35	2,090	123
62	2,458	206	Tobermorray -	75	1,224	232
12,994	657,310	47,300		13,115	626,851	46,576

ACCOUNT—*continued.*

For the Year 1807, ending 5th January 1808.

Coasters. Inwards. No. of Vessels.	Tonnage.	No. of Men.	PORTS.	Coasters. Outwards. No. of Vessels.	Tonnage.	No. of Men.
919	66,797	4,449	Aberdeen -	762	52,583	3,855
315	16,266	1,122	Banff - -	233	10,953	818
168	5,495	4,80	Ayr - -	183	6,475	563
443	22,300	1,423	Alloa - -	1,027	51,053	3,188
344	14,430	981	Anstruther -	244	8,488	637
756	44,506	2,849	Borrowstounness -	1,848	100,001	5,206
164	7,463	554	Caithness or Thurso	230	8,004	790
192	6,062	627	Campbeltown -	261	7,253	828
502	18,471	1,353	Dumfries -	248	10,266	692
361	17,844	1,098	Dunbar -	122	6,272	385
918	56,156	3,767	Dundee -	838	43,045	3,154
86	3,959	278	Fortwilliam -	82	3,718	254
365	22,415	1,427	Inverness -	267	16,022	973
141	4,887	368	Irvine - -	144	2,686	345
11	351	36	Islemartin -	23	970	108
615	24,865	2,101	Kirkaldy -	851	34,768	2,812
209	8,777	603	Kirkcudbright -	188	7,694	508
2,252	138,657	10,359	Leith - -	949	71,941	4,970
801	39,623	3,084	Montrose -	434	20,707	1,611
150	5,516	444	Oban - -	143	4,686	411
59	3,527	285	Orkney or Kirkwall	68	3,997	328
809	38,953	2,679	Perth - -	438	21,181	1,415
162	8,683	454	Port-Glasgow -	193	12,871	755
970	42,623	2,917	Glasgow -	873	33,965	2,440
540	27,833	2,175	Greenock -	700	29,586	2,257
193	7,851	552	Prestonpans -	113	3,621	365
410	12,459	1,454	Rothsay -	432	10,750	1,395
36	1,754	167	Stornoway -	64	2,477	250
113	3,612	274	Stranraer -	158	5,208	377
7	301	20	Portpatrick -	1	56	3
53	1,406	135	Tobermorray -	73	1,122	182
122	4,915	342	Wigtown -	145	6,245	432
42	2,697	161	Zetland or Lerwick	33	2,313	134
13,229	681,454	49,018		12,368	600,977	42,441

ACCOUNT—*continued.*

For the Year 1808, ending 5th January 1809.

Coasters. Inwards. No. of Vessels.	Coasters. Inwards. Tonnage.	No. of Men.	PORTS.	Coasters. Outwards. No. of Vessels.	Coasters. Outwards. Tonnage.	No. of Men.
911	64,457	4,254	Aberdeen - -	784	50,683	3,643
306	16,386	1,055	Banff - -	228	9,764	776
127	4,580	375	Ayr - - -	186	3,831	493
457	25,490	1,514	Alloa - - -	1,010	50,112	3,074
343	12,976	926	Anstruther -	247	9,123	675
706	42,563	2,581	Borrowtounness -	1,914	103,023	6,243
166	8,252	569	Caithness or Thurso	197	7,575	728
188	5,511	619	Campbeltown -	219	6,586	726
541	20,504	1,483	Dumfries - -	227	9,535	637
348	17,657	1,697	Dunbar - -	126	6,460	406
967	59,489	4,030	Dundee - -	318	43,058	3,221
74	3,425	225	Fort-William -	93	4,524	295
446	27,806	1,669	Inverness - -	269	18,583	1,178
135	4,353	347	Irvine - -	166	4,780	412
18	616	65	Islemartin -	19	666	63
535	22,662	1,749	Kirkaldy -	871	35,788	2,799
105	7,248	508	Kirkcudbright -	209	9,318	580
2,074	129,388	8,403	Leith - -	989	76,154	5,218
797	41,489	3,184	Montrose - -	379	18,807	1,434
151	5,668	489	Oban - -	168	4,749	474
85	4,936	422	Orkney or Kirkwall	69	4,457	392
886	43,158	2,978	Perth - -	262	12,448	864
145	8,266	510	Port-Glasgow -	164	11,682	470
885	39,478	2,696	Glasgow -	847	36,448	2,529
512	23,219	1,717	Greenock -	608	26,684	1,959
212	8,662	638	Prestonpans -	62	2,609	193
329	8,612	1,028	Rothsay -	372	8,434	1,087
36	1,754	154	Stornoway -	49	2,392	216
137	3,596	203	Stranraer -	166	5,361	404
5	222	13	Portpatrick -	1	52	2
57	1,790	176	Tobermorray -	94	1,653	246
136	5,225	338	Wigton - -	147	6,418	395
38	2,667	180	Zetland or Lerwick	40	2,786	206
12,938	672,105	46,795		11,500	594,545	42,038

ACCOUNT—*continued.*

For the Year 1809, ending 5th January 1810.

Coasters Inwards.			Ports.	Coasters Outwards.		
No. of Vessels.	Tonnage.	No. of Men.		No. of Vessels.	Tonnage.	No. of Men.
1,026	73,970	4,816	Aberdeen - -	799	51,989	3,760
328	15,994	1,133	Banff - -	325	9,078	740
154	5,045	434	Ayr - -	181	5,746	489
388	19,960	1,138	Alloa - -	902	52,849	2,685
431	16,611	1,154	Anstruther - -	265	9,149	665
746	44,252	2,696	Borrowstounness	2,402	113,240	7,321
256	11,253	803	Caithness or Thurso	180	8,684	597
202	6,271	639	Campbeltown -	199	6,240	645
485	18,035	1,288	Dumfries - -	276	11,445	758
380	18,566	1,172	Dunbar - -	155	7,516	483
1,234	70,032	4,774	Dundee - -	872	35,494	3,386
71	3,499	218	Fort William -	96	4,658	301
416	26,167	1,551	Inverness - -	579	38,896	2,432
131	4,736	363	Irvine - -	165	4,316	412
15	441	46	Islemartin - -	15	535	48
566	23,718	1,773	Kirkaldy - -	864	35,747	2,751
185	7,299	511	Kirkcudbright -	194	8,870	566
2,765	162,299	10,167	Leith - -	1,113	84,412	5,028
901	47,575	3,348	Montrose - -	383	19,318	1,316
160	5,336	487	Oban - -	226	4,732	638
72	4,109	367	Orkney or Kirkwall	74	4,262	370
865	40,125	2,974	Perth - -	430	19,214	1,388
147	7,546	476	Port Glasgow -	182	12,103	657
915	41,238	2,826	Glasgow - -	841	35,805	2,555
514	24,654	1,742	Greenock - -	592	27,550	1,921
205	8,506	599	Prestonpans -	80	3,529	234
365	9,935	1,101	Rothsay - -	387	9,892	1,183
32	1,559	147	Stornoway - -	35	1,571	156
139	4,238	348	Stranraer - -	141	4,140	346
8	298	20	Port Patrick -	—	—	—
51	1,643	140	Tobermorray -	68	1,804	185
145	5,634	404	Wigtown - -	155	6,128	411
33	2,015	177	Zetland or Lerwick	29	1,798	158
14,331	692,559	50,832		13,205	610,710	44,589

ACCOUNT—*continued.*

For the Year 1810, ending 5th January 1811.

Coasters Inwards. No. of Vessels.	Coasters Inwards. Tonnage.	No. of Men.	PORTS.	Coasters Outwards. No. of Vessels.	Coasters Outwards. Tonnage.	No. of Men.
1,100	78,676	4,851	Aberdeen - -	730	47,768	3,218
342	17,137	1,194	Banff - -	237	9,645	762
158	5,876	469	Ayr - -	231	6,748	599
424	21,754	1,226	Alloa - -	919	45,352	2,663
466	17,743	1,142	Anstruther - -	199	6,430	445
713	41,492	2,575	Borrowstounness -	2,477	112,418	7,040
242	10,953	819	Caithness or Thurso	235	10,698	809
240	6,803	815	Campbelltown -	189	5,737	636
570	21,891	1,225	Dumfries - -	283	13,209	825
358	16,949	1,087	Dunbar - -	156	6,989	495
1,187	47,380	4,820	Dundee - -	868	46,426	3,654
90	4,009	264	Fort William -	140	6,643	418
478	30,542	1,795	Inverness - -	460	26,599	1,765
119	4,614	360	Irvine - -	152	4,208	382
14	678	49	Islemartin - -	22	965	72
678	28,203	2,181	Kirkaldy - -	933	33,941	2,763
237	9,051	636	Kirkcudbright -	201	8,646	560
2,920	167,928	10,064	Leith - -	1,510	96,552	6,151
948	50,228	3,315	Montrose - -	447	22,191	1,519
213	6,631	621	Oban - -	282	5,601	814
99	4,938	391	Orkney or Kirkwall	88	4,547	357
875	41,506	2,645	Perth - -	431	20,036	1,325
164	8,772	510	Port-Glasgow -	247	16,612	806
1,111	53,419	3,506	Glasgow - -	982	43,377	3,081
583	31,497	2,278	Greenock - -	811	99,935	2,576
208	7,241	606	Prestonpans - -	90	4,119	283
474	14,657	1,580	Rothsay - -	372	10,519	1,257
35	1,809	162	Stornoway - -	53	2,436	223
135	4,451	348	Stranraer - -	124	4,183	321
5	203	14	Portpatrick - -	1	52	4
44	1,316	122	Tobermorray -	64	1,623	168
161	6,576	434	Wigtown - -	147	6,174	425
51	3,248	252	Zetland or Lerwick	49	3,047	235
54	3,416	207	Grangemouth -	46	3,066	176
15,496	771,587	51,563		14,176	736,492	45,827

ABSTRACT of the aforegoing ACCOUNT.

Coasters Inwards. No. of Vessels.	Coasters Inwards. Tonnage.	No. of Men.	Years.	Coasters Outwards. No. of Vessels.	Coasters Outwards. Tonnage.	No. of Men.
12,332	620,934	41,808	1802	12,144	533,995	43,570
12,456	600,579	47,140	1803	12,306	568,784	45,849
11,913	613,905	44,189	1804	11,429	526,259	39,664
12,644	564,374	42,199	1805	12,136	569,037	42,475
12,487	610,882	44,192	1806	13,039	606,735	44,178
12,994	657,310	47,300	1807	13,115	626,851	46,576
13,229	681,454	49,018	1808	12,368	600,977	42,441
12,938	672,105	46,795	1809	11,500	594,545	42,033
14,331	692,559	50,832	1810	13,205	640,710	44,589
15,496	771,587	51,563	1811	14,176	736,492	45,827
130,820	6,485,689	465,036	Totals.	125,418	6,004,385	437,207

CUSTOM-HOUSE, EDINBURGH, *12th February*, 1812.

ALEX. MITCHELL, *Register of Shipping.*

No. II.—ABSTRACT OF THE CONSTITUTION AND OBJECTS OF THE BANK OF SCOTLAND.

I. THE BANK of SCOTLAND is a public National Establishment, erected and regulated by the Legislature, and not by private contract. Wm Parl. 1. § 5. 14. Geo. 3. c. 32. 24. Geo. 3. c. 8. 32. Geo. 3. c. 25. 34. Geo. 3. c. 19. 44. Geo. 3. c. 23.

II. The statutory capital is at present One Million and a Half of Pounds Sterling. It is raised by voluntary subscription, and has been subscribed for. One million has been called for, and paid in. 44. Geo. 3. c. 23.

III. Subscribers, if not under obligations to the Bank, may, at pleasure, transfer their right. If under obligation to the Bank, the obligation must be previously liquidated, or the proceeds of the sale applied towards such liquidation. Transfers are made by a short assignment and acceptance thereof, both in a register appointed for that purpose. The expense, besides the Government stamp, is eleven shillings. Wm Parl. 1. § 5. Wm Parl. 1. § 5.

IV. Bank of Scotland Stock may be acquired, in any portions, by any person, community, or other lawful party whatsoever, without Selection, Exclusion, or Limitation of Numbers. Wm Parl. 1. § 5. 44. Geo. 3. c. 23.

V. Bank of Scotland Stock may be conveyed by latter-will; and, if specially mentioned, without expense of confirmation. It cannot be arrested; but the individual holder's right may be adjudged. Dividends may be arrested. Wm Parl. 1. § 5.

VI. The Bank of Scotland is a public Incorporation by act of Parliament. Its transactions are distinct from those of individual stockholders, and theirs from those of the Bank. Wm Parl. 1. § 5.

VII. The establishment is expressly debarred from any other business than that of banking. Wm Parl. 1. § 5.

VIII. The management is vested in a Governor, Deputy-Governor, twelve Ordinary, and twelve Ex- Wm Parl. 1. § 5.

14. Geo. 3. c. 32. 44. Geo. 3 c. 23. traordinary Directors. They are all chosen annually, on the last Tuesday of March, by the Stockholders at large. The Governor must hold, at the least, 2000*l.* of stock; the Deputy-Governor, 1500*l.*; and each Director, 750*l.* They swear to be equal to all persons. L.250 of Stock give a vote in election of Directors. Proprietors above 250*l.* have a vote for each 250*l.*, to the extent of 5000*l.* None can have above twenty votes.

Wm Parl. 1. § 5. IX. The executive part is conducted by a Treasurer, Secretary, and other public Officers, all sworn. Those having the official charge of cash, find due security. No Director can hold any inferior office.

Wm Parl. 1. § 5. X. The Board of Directors sits, and the general administration of the Bank, and local business of Edinburgh, are conducted, at the Bank's public head office there. For the other parts of the kingdom, the Bank has its regular public offices in the principal towns thereof, under the official and subordinate administration, to the extent, and in the terms after-mentioned, of its Agents, and counter-check of its Accountants. Its agents give due security.

Resolution of Court, 28. February 1793. XI. The Bank takes in money, at all its public offices, on deposit receipts or promissory notes. At the head office, draughts on London, or on any of the agencies, are given. At each agency, draughts on London, or on the head office, are given. All these documents are *on the Bank's engraved check*, and *sealed with the Bank's seal.* They are signed, if at Edinburgh, by the Treasurer, and countersigned by the principal Accountant. If at an agency, they must be signed by the Bank's agent *as agent*, and *countersigned by the Bank's accountant* for that agency; otherwise they infer no obligation on the Bank.

Resolution of Court, 5. October 1810. XII. The Bank, which, till lately, allowed only 3 per cent. on money deposited with it at its head office, now allows 4 per cent. on money so deposited, if it lye six months.

Resolution of Court, 23. February 1789. XIII. Bills on London, Edinburgh, or any town where the Bank has its official correspondents, are discounted, and purchased at all the Bank's public offices. The Bank's agents judge, in ordinary cases, of the bills presented, so that parties meet with no delay. The Bank does not sell, at any of its offices, the bills which it has discounted and purchased. Its agents can indorse its bills only officially to the Treasurer.

XIV. The Bank gives credit on cash-accounts at any of its offices, on bond, with security. Applications for cash-accounts are judged of by the Court of Directors alone. Such applications are given in to the office where the cash-account is wanted, and must specify the credit desired, and the names and designations of the applicant and proposed co-obligants, and of individual partners, where copartneries are proposed. By these credits, accommodations are given to Commerce, Manufactures, and Agriculture. Repayments are taken as often as convenient. It is understood that these credits are not used as dead loans, to produce interest only. In the fair course of business, the advantage of the Bank is consulted by an active circulation of its notes, and by frequent repayments to it in a way least affecting that circulation.

Resolution of Court, 23. February 1789.

XV. The Bank of Scotland lately divided seven per cent., and now divides seven and a half per cent. per annum, on that part of its capital stock, or one million of pounds Sterling, paid in. The dividends are paid regularly twice a year, without expense. They may be drawn at any of the Bank's offices. As the Bank pays property-tax, as a public Incorporation, the full dividends are paid to the individual stockholders, without retention or deduction of property-tax; and the individual stockholder is not chargeable with property-tax for the dividend so paid to him.

Acts of General Meetings, Sept. 24. 1810. March 26. 1811.

Published by Order of the COURT OF DIRECTORS, *8th April*, 1811.

CHAP. XVI. APP. No. 6.

EXTRACTS *from a* PAPER *read before the* STATES *of* SWEDEN *in a General Diet held at Stockholm in* 1746 *and* 1747, *entitled the 'Dutch Gold Mine.'*

ABOUT 200 years ago, an Englishman, William Belkinson, taught the Dutch the manner of dressing, salting, and barrelling herrings. He taught them how to take and salt cod upon the sea coasts. So industrious were the Dutch, and so much did the trade increase, that in 1601 the Dutch fitted out 900 vessels, and 1500 busses, for the cod and herring fishery. Each of these 1500 busses employed other three vessels to supply them with salt and empty barrels, and to transport the fish; so that 6900 vessels were employed in this trade.

Sir Walter Raleigh assured James I. that the Dutch fished on the coasts of Britain with 3000 vessels, and 50,000 men, exclusive of the vessels employed in transporting their herrings to other countries; which, according to him, amounted to 9000, and 150,000 men. He added, that 20 busses of herrings were sufficient for the maintenance of 8000 souls, comprehending women and children; and that the Dutch had annually 20,000 vessels at sea for the sole article of fishing.

M. D'Aitzema, resident from the Hans Towns at the Hague, and the celebrated Du Morelin, certify, that in their time the Dutch drew from the sea 300,000 tons of herrings and other salt fish.

Dr Benjamin Worsley, Secretary of State for the Departments of Trade and Plantations to Charles II., was sent to Holland in 1667 to inform himself exactly of the fishery which the Dutch carried on in the North Sea. By his report, the Dutch herring fishery amounted to three millions Sterling. He proved this by the number of busses, then 1600;—by the quantity of fish taken by each buss;—by the customhouse accounts of Holland, Zealand, and Friezland;—and by the price of fish in every place to which the Dutch went. This value exceeded the manufactures of England at that time, or the mines of America.

Sir Walter demonstrated, that 1000*l.* employed in the fishery maintained more people than 5000*l.* in any other branch of commerce. One buss bred 10 sailors.

De Witt, the pensionary, published his work in 1662, viz. the '*Fundamental Maxims of the Republic of Holland;*' and he calculates that 750,000 people lived by the fishery.

CHAP. XVI. APP. No. 7.

AN ACCOUNT OF THE PRINCIPAL ROADS IN SCOTLAND.

FROM that laudable spirit of improvement which of late years has every where manifested itself in Scotland, substantial roads have been made in all directions. The great leading highways being connected by cross roads, the communication with the towns, villages, and sea-ports, is open to every district or parish; and thus, the products of industry are freely circulated throughout every part of the kingdom. The following roads, however, may be considered the principal highways in Scotland; and they are *turnpike* over their greatest extent, with the exception of those in the Highlands termed *military*, from having been made by the army; and those also in the northern districts where the public aid has rendered the collection of toll-dues unnecessary; and where, indeed, from the small number of travellers, any toll that might be levied would not probably defray the expense of the collection.

1*st*, *Roads from Edinburgh to England, the Western Coast of Scotland*, &c.—From the extremity of Caithness to the borders of England, it may be said that the country is now intersected by roads in every direction.* But for the sake of distinct enumeration, we shall first mention those which, diverging from Edinburgh, intersect the southern and western counties of Scotland. From Edinburgh to Berwick, a great road passes through Haddington and Dunbar, 55 miles. Another road goes through Dalkeith and Lauder, to Jedburgh, 45 miles; and thence to Newcastle-upon-Tyne. A third road passes through Middleton and Melrose, to Jedburgh, 46 miles. These roads intersect the shires of Edinburgh, Haddington, Roxburgh, and Berwick. In a western direction, two roads go from Edinburgh to Carlisle, in England;—the one, through Middleton and Bankhouse, to Hawick, 47 miles—the other through Howgate and Peebles, to the same place, 54 miles; and thence by Langholm to Carlisle. In a still more westerly direction, two roads pass from Edinburgh to Dumfries;—the one by Howgate and Moffat, 71 miles—and the other by Linton and Moffat, 74 miles. These roads intersect the counties of Edinburgh, Peebles, and Dumfries. Two roads also go from Edinburgh to Kirkcudbright, and to Wigton and Whithorn. The one passes through Biggar, &c. to Kirkcudbright, 99 miles—and the other, through Linton, Dolphington, and Biggar, to Whithorn, 116 miles. These roads

* About 12 miles from Wick to Thurso remain to be completed, but the necessary measures are taking for that purpose.

intersect the shires of Edinburgh, Peebles, Lanark, Dumfries, Kirkcudbright, and Wigton. From Edinburgh to Ayr, there are two roads; and thence one proceeds along the Frith of Clyde to Port-Patrick, on the Irish Channel, 129 miles from Edinburgh. Three roads go from Edinburgh to Glasgow;—the first by Holytown, 44 miles—the second by Airdrie, 43 miles—and the third by Falkirk, 48 miles. These roads intersect the shires of Linlithgow, Lanark, and the western counties of Scotland.

2*d*, *Roads from Glasgow to England, and the Western Coast of Scotland.*—From Glasgow, a road passes through Hamilton and Moffat to Gretna, 88 miles; and thence to Carlisle. Two roads also extend to Dumfries;—the one by Kilbride, Strathaven, and Sanquhar, 72 miles—and the other, by Kingswells, Mauchline, and Sanquhar, 80 miles. A road goes from Glasgow by Kilmarnock to Ayr, 34 miles—and thence to Portpatrick, 53 miles—in all from Glasgow, 87 miles. It also goes in another direction from Ayr to Whithorn, 63 miles from Ayr. These roads intersect the shires of Lanark, Renfrew, Ayr, Wigton, Kirkcudbright, and Dumfries.

3*d*, *Roads from Edinburgh to the Eastern and Northern Districts of Scotland.*—From Edinburgh, a road extends through Fife, by Kinghorn Ferry and Cupar, to Dundee—thence, by Arbroath, Montrose, Bervie, and Stonehaven, to Aberdeen, 108 miles. A road goes to Stirling from Edinburgh, by North Queensferry, Culross, and Alloa, 37 miles; and another road passes through North Queensferry and Kinross to Perth, 40 miles—and thence to Dundee, 23 miles. These roads intersect the counties of Fife, Clackmannan, Stirling, Kinross, Perth, Angus, and Mearns.

4*th*, *Roads from Glasgow to the Eastern and Northern Districts of Scotland.*—From Glasgow, a road passes through Stirling to Perth, 65 miles—and thence to Dundee, where it unites with the great post-road to Aberdeen. Another road extends from Glasgow by Dumbarton, Luss, Inverary, and Tyndrum, to Fort-William—and thence by Fort-Augustus to Inverness, 191 miles. These roads intersect the shires of Lanark, Stirling, Perth, and Angus, in the one direction; and in the other, the counties of Dumbarton, Argyle, and Inverness.

5*th*, *Roads from Perth to Inverness, and to Aberdeen.*—From Perth, a Highland road extends by Dunkeld, Blair of Athol, Dalwhinnie, Bridge of Spey, and Aviemore, to Inverness, 115 miles. This road branches off from Dalwhinnie to Fort Augustus, 31 miles, where it meets the road from Inverness to Fort-William. Another Highland road, from Stirling to Fort-William, passes by Doune, Callander, and Tyndrum, 92 miles. From Perth, a great post-road extends to Aberdeen by Cupar in Angus, Forfar, Brechin, Laurencekirk, and Stonehaven, 84 miles—which intersects the interior of the counties of Angus and Mearns.

6th, Roads from Aberdeen to Inverness.—From Aberdeen, the road branches off in several directions to Fochabers on the banks of the Spey:—1*st*, By Ellon, Peterhead, Frasersburgh, and Banff, 64 miles: 2*d*, By Old Meldrum, Banff, Portsoy, and Cullen, to Fochabers, 71 miles: 3*d*, By Kintore, Huntly, and Keith, to the same place, 54½ miles. These lines, terminating at Fochabers, are united into one road—passing through Elgin, Forres, and Nairn, to Inverness, 47½ miles—or in all 118¾ miles by the centre road.

7th, Road from Inverness to Thurso.—From Inverness, the road extends by Dingwall, Tain, Dornoch, and Wick, to Thurso, intersecting the shire of Ross, and stretching along the eastern coast of Sutherland and Caithness—in all 134¾ miles from the town of Inverness to the extremity of the island.

Although the above mentioned are the principal highways, yet there are many other roads which pass in all directions throughout the whole extent of Scotland.

CHAP. XVI. APP. No. 8.

ON BRIDGES.

By Mr RICHARD CHRICHTON, Architect, Edinburgh.

A FULL and complete description of all sorts of bridges, with the most approved manner of erecting them, in all varieties of situation and circumstances, would require a separate treatise, and far exceed the limits of the present article. It is therefore only proposed to explain the properties essential to well formed bridges of wood, iron or stone.

The essential requisites of all bridges are, chiefly, that they form a safe and easy road across a river or chasm: That they afford a free passage to the river, so that in time of floods the road beyond the bridge may not be overflown, or the bridge endangered by the pressure of the water; and that they be so constructed as to render them of the greatest possible durability.

All bridges should cross the river at right angles to the current: to suit which it often becomes necessary to make turns in the line of road leading to the bridge; but although this may be unavoidable where the river is of some magnitude, yet there are few roads where we do not find bridges built over trifling rivulets, to which very inconvenient, and sometimes hazardous turns have been made from the line of the road, owing to the bridge being built at right angles to the stream as it chanced to run, when the same, and often less expense than the forming of such awkward turns would have cut and banked up the channel of the rivulet, so as to cause it cross the road at right angles, and of course admit of the bridge being built to suit the road.

The most ancient bridges of Scotland were built at a greater expense, than at present, considering the then value of money. In 1320, Bishop Cheyne built the bridge of Don, near Aberdeen, from the emoluments of his See, while it was sequestrated by King Robert Bruce, and he was reinstated by that King. Bishop Elphinston left money for building a bridge of 7 arches over the Dee, near Aberdeen, which was accomplished by Bishop Gavin Dunbar about 1510. And the oldest toll in Scotland is for building a bridge over the Earn, which was executed by the Magistrates of Perth about 1200 years ago. The building of bridges is now better understood.

Bridges of Wood.

This material is used either for cheapness, where the price of stone cannot be obtained; for expedition in the formation, in cases where the time of constructing one of more durable materials cannot be allowed, or when other materials would not suit the purpose, as in cases where the distance of the supports is very great.

The great inferiority of bridges of wood consists in the want of durability. Particular attention should therefore be given, that none but the very best red wood be used, entirely free of sap; all the ends of the beams to be covered by the abutments, or driven into the soil, should be charred and covered with boiled tar; all the joints should be painted with white lead and lintseed oil before they are fastened, and the whole structure either painted with the same materials, or at least covered with boiled tar. The covering for forming the road should not be laid flat upon the beams, but raised about one inch above them by narrow fillets, so as no lodgment may be formed for moisture to remain upon any part of the timbers, and all the parts to be so constructed as to receive at all times a free current of air.

Bridges of this material may, where the stretch is short, be formed by simple straight beams resting upon the abutments at each end, with the covering laid across. Mr Nasmyth, landscape painter, Edinburgh, has suggested an ingenious method of constructing bridges by layers of thin plank laid together in the manner of a spring for a carriage, and by these forming an arch of the extent required, similar to a bow with its cord; the planks being kept in their bent position by their fixtures at the abutments, and by a beam of wood, cord, or bar of iron, fixed to the opposite ends, and placed in a straight line betwixt them, with ties to the arch formed by the planks at proper distances, to keep them in a regular curve.

For stretches not exceeding 30 or 40 feet, a bridge may be formed in a cheap and expeditious manner by four beams or trunks of trees with two cross bearers, placed as here represented. A B the opposite banks; C, C, C, C, four beams or trunks

of trees firmly secured at the ends upon the banks, laid at the breadth of the road apart, of length sufficient to cross each other over the middle of the space, about 10 or 12 feet, and resting there upon the cross-bearers D, D, which are kept in their place by the pins F, F, &c. These bearers thus secured are then to be covered with spars or planks F, which form the road, on which also a railing G may be fixed by way of parapet, and thus form a strong and useful bridge of the rudest materials, which may be as durable as the materials, by giving proper attention that the ends of the beams C are well secured from shifting by the opposite banks, and that the cross bearers D are kept in their places by the pins E, where they may also be fastened by a hoop of iron or rope.

Bridges of wood have been formed over rivers of great width from bank to bank, without any intermediate support. The largest of this kind was that over the Rhine at Schauffhausen, constructed by Ulric Grubenman in 1758, and destroyed by the French army in 1799. The extent from bank to bank was 364 feet, the rise about 30 feet and 18 feet broad. It was formed upon the principles given by Palladio, in his designs for wooden bridges.

The largest bridge of this kind in Scotland is that over the Don on the Banff road, seven miles from Aberdeen, constructed by James Burn of Haddington in 1803. The span is 109 feet 3 inches, with 13 feet 4 inches of rise, the width 18 feet. Mr Burn has also erected several other similar bridges in the north of Scotland, all of which have great merit in the construction. They consist of a series of frames in the form of an arch, laid horizontally across the soffit. The width of the bridge has two rows of these frames, which form two ribs, upon which a vertical framing is constructed to support the bearers, road, &c.*

* Such a construction might be useful in military services.

Wooden bridges across rivers of great width are supported on piles driven into the bottom of the river, of which kind the largest in Scotland is that erected about eighteen years since at Montrose, by the late Mr Stevens, over an inlet of the sea, 600 feet across and 32 feet deep at high water; a structure of great benefit and consequence to all the surrounding country; but, from the perishable nature of the materials, requiring constant repair. It may, however, be worthy of remark, respecting this bridge, that the failure is principally in the fir piles in the middle, which are about 60 feet long and 2 feet square, being rapidly destroyed by an insect, in the space between low and high water mark. The piles of oak have not been destroyed in the same manner, and all the knots in the fir remain untouched.

Bridges of Iron.

The introduction of cast-iron for forming bridges constitutes a new era in that science, and is wholly a British invention. The first of this material was erected over the Severn near Colebrookdale, county of Salop, in 1777, under the direction of Abraham Derby. The span is 100 feet 6 inches, the rise 45 feet. Since which several others of larger dimensions have been executed, particularly that at Sunderland, whose span is 236 feet, the versed line or rise of the arch 34 feet, and the height above low water 100 feet. The first bridge is still standing: great improvements have since been made in the construction, and there is no doubt many more will still be added.

One great cause of weakness in these bridges is the difficulty of securing the abutments. The great span, and the elasticity of the materials of such bridges, subject them to great vibration, which constantly acting upon the abutments is progressively working their destruction. Every means must therefore be used to make the abutments firm. The most effectual would be to make the arch broader at the spring than in the middle, perhaps double the breadth, which would very much tend to lessen the vibration, and render the whole structure firm and secure.

Bridges of Stone.

Of all the materials with which bridges may be formed, none can be compared with stone, for strength and durability.

The most essential parts in the construction of stone bridges are the foundation of the piers and abutments, and the form of the arch. Bridges of more than one arch should not, if it possibly can be avoided, be built where the current is rapid. All foundations not upon rock, and exposed to the current of the water, should be well protected by embankments formed with stones, and kept together with piles and cramps. The piers of all bridges with flat arches should be of a height equal to the surface of the water when highest. Where the arches rise above one-third of the span, the piers may be somewhat lower. The thickness of piers depends very much on the height and form of the arch, and from these circumstances will vary from one-fourth to one-eighth of the span of the arch. Under low water, the piers must increase in breadth about three inches in every foot of height, which may be taken off in steps at the height of every course, observing never to make large scarcements or intakes at once, as it would thereby come within the solid of the stretchers in the under course of stones. All the piers should be built solid with square stones, having headers over the centre of every stretcher, and all the sides of the stones squared the whole way back.

The size and form of the arches will very much depend on the height of the banks on each side of the river. The convenience of the road requires the bridge to rise as little in the middle as possible, and never above one in twenty-four. Where the banks are low, therefore, circular arches, having the versed sine or rise not above one-fourth of the span, will suit best; and, as the materials of the arch are the most expensive, such arches having the shortest length of curve will be the most economical. The lateral pressure of arches is greater in proportion as they are less than the semicircle, and therefore the strength of the abutments must increase with the flatness of the arch. In cases where the piers are high on account of the depth of water, the abutments will become expensive for arches with a small rise; and where the line of the road above will not admit of their being raised, arches of a semielliptic form may be introduced with advantage, as they press upon the piers and abutments in the same manner as those of a semicircle. The depth of the arch stones must be in proportion to the radius of the curve, which is a circumstance to be particularly attended to, as the size of the arch stones materially affects the expense. The hardness or softness of the stones will require some consideration in fixing the proper depth; but in common it will be found, that the depth of the arch should be one-twelfth of the length of the radius: thus a semicircular arch of 100 feet span, whose radius is 50 feet, requires the arch stones to be 4 feet 2 inches deep, and so on of others.

All the beds or joints of the arch stones must be in the line of the radius.

Mathematicians have made numerous and intricate calculations of the equilibrium of arches; but as most of these have not included the parts joined to the arch, and necessary to form a bridge, they have not been of much use in the practical operations. The great variety of constructions now existing, with the failure and destruction of many, under a variety of circumstances, have enabled engineers to form correct principles suited to the construction of bridges in all the variety of situations.

In all bridges the piers should be built up solid to about one-third of the rise of the arch, extending to the ends of the arch stones. A wall should then be built upon the centre of the pier, to near the levelling for the road, and the space betwixt that wall and the top of the arches formed into void spaces, by walls from 18 inches to 2 feet thick, built longitudinally from the piers to the arch, at from 4 to 6 feet distance, and either arched with high pointed arches to carry the road, or covered from wall to wall with long flat stones. In this manner the arches will not be overloaded, and by avoiding all filling up with loose materials within the building, it will not be liable to the accidents which have occasioned the ruin of many such structures.

The arch of the largest span in Britain is the Ponty Pridd over the Taafe in Glamorganshire, built in 1755, being 140 feet with 35 feet of rise; but it is very narrow, being only 11 feet. The greatest bridge of one arch is that lately built at Aberdeen, whose span is 130 feet, the rise 29 feet, and breadth within the parapets 40 feet.

CHAP. XVI. APP. No. 9.

THE FIARS of CLACKMANNAN-SHIRE, WITH PROGRESSIVE AVERAGES OF TWENTY, TEN, AND SEVEN YEARS.

WHEAT,

Per Boll, containing 4 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.7814 *Pottle.*

Crops.	Annual Price.	20 Years Average.	10 Years Average.	7 Years Average.
	s. d.	*s. d.*	*s. d.*	*s. d.*
1712	13 4	—	—	—
13	12 9¼	—	—	—
14	11 8	—	—	—
15	13 4	—	—	—
16	13 9½	—	—	—
17	12 9¼	—	—	—
18	12 6	—	—	12 8¾
19	12 9¼	—	—	12 7¾
1720	11 8	—	—	12 6
21	11 8	—	12 6¼	12 6
22	13 4	—	12 6¼	12 6
23	11 8	—	12 5	12 4
24	11 8	—	12 5	12 2¼
25	16 0	—	12 6	12 6½
26	15 0	—	12 9¾	12 10¼
27	15 0	—	13 0¼	13 4
28	15 0	—	13 3¼	13 9¾
29	15 0	—	13 6	14 0½
1730	11 8	—	13 6	14 0½
31	12 6½	13 0¾	13 7	14 2
32	10 0	12 10¼	13 3	13 5½
33	11 8	12 10	13 3	12 11¾
34	14 4	12 11	13 6¼	12 10½
35	15 0	13 0½	13 6¼	12 10½
36	13 4	13 1	13 4¼	12 7¾
37	12 6	13 0¼	13 1¼	12 9
38	10 0	12 11¼	12 7¼	12 5
39	13 4	12 11½	12 5¼	12 10¼
1740	21 0	13 5¼	13 4¼	14 2½

The FIARS of CLACKMANNAN-SHIRE—*continued.*

WHEAT,

Per Boll, containing 4 Bushels, 1 Peck, 1 Gallon, 0.7814 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1741	11	8	13	5¼	13	3¼	13	10
42	11	8	13	4¼	13	5¼	13	4¾
43	10	0	13	3¼	13	3¼	12	10½
44	11	0	13	2¾	12	11¼	12	8
45	14	2	13	2¼	12	10¼	13	3
46	12	6	13	0¾	12	9¼	13	1¾
47	12	6	12	11¼	12	11¼	11	11
48	14	2	12	10¾	13	2¾	12	3½
49	13	4	12	9¾	13	2¼	12	5
1750	13	10	12	11	12	5¾	13	0¾
51	14	2	13	0¼	12	8¾	13	6¼
52	13	4	13	2	12	10¾	13	4¾
53	14	2	13	3¾	13	3¾	13	7¾
54	12	10	13	2¾	13	6	13	8¼
55	15	0	13	2¾	13	7	13	9¾
56	20	0	13	6¾	14	4	14	9
57	16	8	13	9½	14	9	15	2
58	15	0	14	0¼	14	10	15	3½
59	14	2	14	0¾	14	11	15	4¾
1760	13	10	13	8¼	14	11	15	4¼
61	14	2	13	9¾	14	11	15	6½
62	18	0	14	1¾	15	4½	15	11¾
63	16	8	14	5¾	15	7½	15	6
64	18	0	14	9½	16	1¾	15	8¼
65	20	0	15	1¼	16	7¾	16	10¼
66	18	6	15	5	16	6	17	0¼
67	19	0	15	8¾	16	8¾	17	9
68	19	0	15	11¼	17	1½	18	5½
69	17	0	16	2	17	5	18	3¾
1770	17	6	16	4¼	17	9¼	18	5

The FIARS of CLACKMANNAN-SHIRE—*continued.*

WHEAT,

Per Boll, containing 4 *Bushels,* 1 *Peck,* 1 *Gallon,* 0,7814 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1771	20	0	16	7½	18	4¼	18	8½
72	22	0	17	0¾	18	9¼	19	0
73	20	0	17	4¼	19	1¼	19	2½
74	20	0	17	8¼	19	3½	19	4¼
75	17	0	17	9¾	19	0	19	0¾
76	16	6	17	7¾	18	9½	19	0
77	20	0	17	9¾	18	10¾	19	4¼
78	17	0	17	11	18	8¼	18	11
79	14	6	17	11¼	18	5¼	17	10¼
1780	18	6	18	2	18	6½	17	7¾
81	18	0	18	4¼	18	4¼	17	4¼
82	23	0	18	7¼	18	5½	18	2½
83	19	0	18	8¾	18	4¼	18	6¾
84	20	0	18	9¾	18	4¼	18	6¾
85	18	6	18	9	18	6	18	9½
86	18	6	18	9	18	8¼	19	4¼
87	19	6	18	9¼	18	7¾	19	6
88	20	0	18	9¾	18	11¼	19	9½
89	23	0	19	1½	19	9½	19	9½
1790	22	6	19	4½	20	2¼	20	3½
91	20	0	19	4½	20	4¾	20	3½
92	20	0	19	3¾	20	1¼	20	3
93	23	0	19	5	20	6	21	1¾
94	22	6	19	6½	20	9	21	6¾
95	45	0	20	11¼	23	4¾	25	1¾
96	26	0	21	5	24	1¾	25	6¾
97	19	6	21	4¾	24	1¾	25	1¾
98	21	6	21	7¼	24	3½	25	4¼
99	35	0	22	7¼	25	6	27	6
1800	60	0	24	8¾	29	3	32	9½

The FIARS of CLACKMANNAN-SHIRE—*continued.*

WHEAT,

Per Boll, containing 4 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.7814 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1801	36	0	25	8¾	30	10¼	34	8½
2	24	0	25	8¼	31	3	31	8½
3	24	0	25	11	31	4	31	5
4	40	0	26	10¾	33	1¼	34	4¼
5	33	0	27	9	31	10¾	36	0
6	35	0	28	3¾	32	9½	36	0
7	31	6	29	0¾	34	0	31	11
8	43	6	30	3	36	2¼	33	0
9	43	0	31	3	37	0	35	8½
1810	34	6	31	10¼	34	5¼	37	2½
11	46	0	33	1¾	35	5¼	38	0¾
12	58	0	35	0½	38	10½	41	7¾
13	34	6	35	7½	39	10¾	41	6¼

The FIARS of CLACKMANNAN-SHIRE—*continued*,

CARSE BARLEY,

Or Barley grown on rich *Carse* or *Clay* soils on the Banks of the Forth.

Per Boll, containing 6 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.3257 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1712	8	4	—		—		—	
13	10	0	—		—		—	
14	13	4	—		—		—	
15	11	1¼	—		—		—	
16	8	4	—		—		—	
17	8	4	—		—		—	
18	8	10¾	—		—		9	9
19	10	0	—		—		10	0
1720	9	2	—		—		9	10½
21	8	4	—		9	7	9	2
22	10	10	—		9	10	9	1½
23	12	2¾	—		10	0¾	9	8¼
24	8	4	—		9	6¾	9	8¼
25	9	5¼	—		9	4¾	9	9¼
26	8	9	—		9	5¼	9	7
27	11	1¼	—		9	8½	9	10¼
28	12	6	—		10	1	10	5½
29	9	4	—		10	0	10	2¾
1730	7	6	—		9	10	9	6¾
31	7	6	9	8¼	9	9	9	5¼
32	7	9¼	9	7¼	9	5¼	9	2½
33	9	2	9	7¼	9	1¾	9	3¼
34	8	4	9	4¼	9	1¾	8	10½
35	9	5¼	9	3¼	9	1¾	8	5¼
36	10	0	9	4¼	9	3¼	8	6¼
37	10	0	9	5¼	9	1¾	8	10¾
38	8	10¾	9	5¼	8	9½	9	1
39	11	4	9	6	8	11¾	9	0½
1740	16	8	9	10½	9	10¼	10	8
41	9	2	9	11	18	1	10	9¼

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE BARLEY,

Per Boll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.3257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1742	9	4	9	10	10	2¾	10	9¼
43	7	8	9	7¼	10	1	10	5¾
44	8	10¾	9	7¼	10	1	10	3¼
45	12	6	9	9½	10	5¼	10	9½
46	11	4¼	9	10½	10	6¾	10	9
47	8	10	9	9½	10	5¼	9	7½
48	9	4	9	7¾	10	5¾	9	8
49	9	0	9	7½	10	3	9	7½
1750	10	6	9	9¼	9	7½	10	0¼
51	11	8	9	11¾	9	10½	10	5
52	13	4	10	3	10	3¼	10	6½
53	13	4	10	5¼	10	10¼	10	10¼
54	9	6	10	6¼	10	11	10	11½
55	11	8	10	7½	10	10	11	8½
56	16	0	10	11¼	11	3¾	12	8½
57	15	0	11	2¼	11	11¼	12	11
58	9	8	11	2¾	11	11½	12	7¾
59	10	0	11	1¾	12	0¾	12	2
1760	9	4	10	9½	11	11¼	11	7
61	10	0	10	10	11	9¼	11	8
62	14	4	11	1	11	10½	12	0½
63	15	0	11	5¼	12	0½	11	10¾
64	15	0	11	9	12	7¼	11	10¾
65	19	6	12	1¼	13	4½	13	3¾
66	18	4	12	5½	13	7¼	14	6
67	17	2	12	10½	13	10	15	7½
68	13	4	13	1	14	2¼	16	1
69	15	0	13	4½	14	8¼	16	2¼
1770	16	0	13	7¾	15	4¼	16	4
71	16	8	13	10¾	16	0¼	16	6¾

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE BARLEY,

Per Roll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.3257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	18	6	14	2	16	5¼	16	5
73	18	0	14	4¾	16	9	16	4½
74	17	6	14	9½	17	0	16	5
75	15	6	14	11¾	16	7¼	16	8¾
76	13	0	14	10	16	0¾	16	5½
77	13	4	14	9	15	8¼	16	0¾
78	14	0	14	11¼	15	9	15	8¼
79	13	0	15	1½	15	6¾	14	10¾
1780	13	6	15	4	15	3¾	14	8
81	13	4	15	6	14	11¾	13	8
82	23	0	15	11¼	15	5	14	8¾
83	18	6	16	1¼	15	5¾	15	6¼
84	19	6	16	4	1[illegible]	8	16	4¾
85	16	6	16	2½	15	9¼	16	9
86	18	0	16	2	16	3¼	17	5½
87	17	0	16	1¾	16	7¾	17	11¾
88	14	6	16	8½	16	8¼	18	2¾
89	18	0	16	10¼	17	2¼	17	5
1790	17	6	16	5¼	17	7	17	3½
91	19	6	16	7	18	2½	17	3½
92	20	6	16	8¼	17	11½	17	10¼
93	19	6	16	9	18	0¾	18	0¾
94	22	6	17	0	18	4¼	18	10¼
95	24	0	17	8¼	19	1¼	20	2½
96	25	0	18	3¼	19	9¾	21	2½
97	17	9	18	6	19	10½	21	3
98	17	6	18	5	20	2	20	11½
99	38	0	19	3¼	21	4½	22	3¾
1800	48	0	21	0	24	5	26	4¾
1	28	6	21	9	25	3½	27	2

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE BARLEY,

Per Boll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.3257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1802	19	0	21	$6\frac{3}{4}$	25	$1\frac{1}{4}$	26	$5\frac{1}{2}$
3	19	0	22	7	25	$1\frac{1}{2}$	25	8
4	31	0	22	$1\frac{3}{4}$	25	11	27	6
5	27	6	22	$8\frac{1}{4}$	26	$3\frac{1}{4}$	29	0
6	30	0	23	$3\frac{3}{4}$	26	$9\frac{1}{4}$	29	0
7	31	0	24	0	28	$1\frac{3}{4}$	26	$6\frac{3}{4}$
8	30	0	24	$9\frac{1}{4}$	29	$4\frac{3}{4}$	26	$9\frac{1}{2}$
9	33	0	25	$6\frac{1}{2}$	29	$8\frac{1}{4}$	28	$9\frac{1}{2}$
1810	34	0	26	$2\frac{1}{4}$	28	0	30	6
11	33	0	26	$10\frac{1}{4}$	28	9	30	$9\frac{1}{2}$
12	42	0	27	$11\frac{1}{2}$	30	9	32	$10\frac{1}{4}$
13	34	6	28	$8\frac{1}{2}$	32	$3\frac{1}{2}$	33	6

The Fiars of Clackmannan-shire—*continued.*

DRYFIELD BARLEY,

Or Barley growing on Uplands.

Per Boll, containing 6 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.3257 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1712	7	2¾	—		—		—	
13	8	4	—		—		—	
14	11	8	—		—		—	
15	10	0	—		—		—	
16	7	2¾	—		—		—	
17	7	6	—		—		—	
18	8	4	—		—		8	7¼
19	9	5¼	—		—		8	11
1720	8	0¾	—		—		8	10¾
21	7	9¼	—		8	6¾	8	4
22	7	8¾	—		8	9¾	8	3½
23	10	6½	—		9	0¼	8	9¼
24	7	9¼	—		8	7½	8	9¾
25	8	4	—		8	5½	8	9¾
26	8	0¾	—		8	6½	8	7¼
27	10	10	—		8	10½	9	0
28	11	8	—		9	2½	9	6¾
29	8	9	—		9	1¾	9	5
1730	6	8	—		9	0	8	10½
31	6	8	8	8¼	8	10¾	8	8½
32	7	2¾	8	8¼	8	7¾	8	6½
33	8	4	8	8¼	8	5¼	8	7
34	7	9¼	8	6¼	8	5¼	8	1¾
35	8	10¾	8	5¾	8	5¾	7	9
36	9	2	8	6¾	8	7¼	7	9¾
37	8	10¾	8	7¾	8	4¾	8	1½
38	7	11	8	7½	8	0¼	8	3¾
39	10	10	8	8¼	8	2¾	8	10
1740	16	0	9	1	9	2	9	11
41	8	4	9	1¼	9	4	10	0

The FIARS of CLACKMANNAN-SHIRE—*continued.*

DRYFIELD BARLEY,

Per Boll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.3257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1742	8	4	9	0½	9	5¼	9	11
43	7	2¾	8	10½	9	4	9	7¾
44	7	2¾	8	10¼	9	3¼	9	4¾
45	11	8	9	0¼	9	6¾	9	11¼
46	10	0	9	1½	9	7¾	9	9¾
47	8	4	9	0	9	7	8	8¾
48	8	10¾	8	10¼	9	8¼	8	9¾
49	8	4	8	10	9	5¼	8	9¾
1750	10	0	9	0	8	10	9	2½
51	10	10	9	2½	9	1	9	8¾
52	12	0	9	5¼	9	5¼	9	9¼
53	11	8	9	7¼	9	10¾	10	0
54	9	0	9	8	10	0¾	10	1¼
55	10	0	9	8¾	9	10¾	10	3
56	15	0	10	0¼	10	4¾	11	2½
57	14	2	10	3½	10	11¾	11	9¾
58	9	0	10	4	11	0	11	6½
59	9	0	10	3	11	0¾	11	1½
1760	8	8	9	10	10	11¼	10	8½
61	9	2	9	11	10	9¼	10	8½
62	13	10	10	2¼	10	11¼	11	3
63	14	0	10	6½	11	2¼	11	1½
64	14	2	10	10½	11	8¼	11	1½
65	17	6	11	2	12	5¼	12	4
66	17	6	11	6½	12	8¼	13	6½
67	15	10	11	11	12	10¼	14	6¾
68	12	0	12	1	13	2	14	11¾
69	14	2	12	4½	13	8¼	15	0¼
1770	15	0	12	7½	14	3¾	15	2
71	15	6	12	10¼	14	11¼	15	4¼

The FIARS of CLACKMANNAN-SHIRE—*continued.*

DRYFIELD BARLEY

Per Boll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.8257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	17	6	13	1½	15	3¾	15	4¼
73	16	8	13	4½	15	7	15	2¾
74	16	0	13	8¾	15	9¼	15	3
75	14	6	13	11½	15	5½	15	7½
76	12	0	13	9¾	14	11	15	3¾
77	12	6	13	8¾	14	7	14	11½
78	13	4	13	11¼	14	8½	14	7¾
79	12	0	14	11	14	6	13	10¼
1780	12	6	14	3¾	14	3	13	3¼
81	12	4	14	5¼	13	11¼	12	8¾
82	22	0	14	10¼	14	4½	13	9¾
83	17	6	15	0¼	14	5½	14	7
84	18	0	15	2½	14	8	15	4½
85	15	0	15	1	14	8½	15	7½
86	17	0	15	0¾	15	2½	16	4
87	16	6	15	1¼	15	7¼	16	10¾
88	13	6	15	2	15	7½	17	0¾
89	16	6	15	3½	16	1	16	3
1790	16	6	15	4¼	16	5¾	16	1¾
91	18	6	15	6¼	17	1¼	16	2½
92	20	0	15	7¾	16	10¾	16	11
93	18	6	15	8¾	17	0	17	1¾
94	21	6	16	0	17	4¼	17	10¼
95	22	0	16	7½	18	0½	19	0¾
96	24	0	17	2½	18	9	20	1¾
97	16	6	17	5¾	18	9	20	1¾
98	17	0	18	4¼	19	1¼	19	11
99	27	6	18	1	20	2½	21	0
1800	48	0	19	11	23	4¼	25	2½
1	27	0	20	7¾	24	2¼	26	0

THE FIARS of CLACKMANNAN-SHIRE—*continued.*

DRYFIELD BARLEY,

Per Boll, containing 6 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.3257 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1802	17	6	20	5¼	23	11¼	25	4
3	17	6	20	2¼	23	3	24	5
4	29	0	20	11¾	24	1¼	26	7¾
5	26	0	21	6¼	25	0	27	6
6	28	0	22	0¾	25	4¾	27	7¾
7	29	0	22	8¼	26	7¾	24	10¼
8	28	0	23	5	27	9	25	0
9	30	6	24	1½	28	0½	26	10¾
1810	28	0	24	8¼	26	0½	28	4¼
11	33	0	25	5	26	7¾	28	11
12	40	0	26	5	28	10¾	30	11
13	33	0	27	1¾	30	5¼	21	7¾

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE OATS,

Or Oats growing on rich Clay Soils.

Per Boll, containing 6 *Bushels*, 1 *Peck*, 1 *Gallon*, 0.3257 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1712	6	8	—		—		—	
13	7	9¼	—		—		—	
14	9	3	—		—		—	
15	8	5¼	—		—		—	
16	6	8	—		—		—	
17	7	2¾	—		—		—	
18	7	9¼	—		—		7	9¾
19	9	3	—		—		8	2
1720	7	9¼	—		—		8	2
21	7	6	—		7	11	7	11½
22	9	5¼	—		8	2¼	7	11½
23	9	5¼	—		8	4¼	8	4
24	6	8	—		8	1¼	8	3
25	8	4	—		8	0	8	4
26	8	0¾	—		8	1¾	8	2
27	8	10¾	—		8	3¾	8	4
28	10	0	—		8	6¼	8	8¼
29	8	4	—		8	5¼	8	6¼
1730	7	6	—		8	5	8	3
31	7	2¾	8	1¾	8	4¾	8	4
32	7	2¾	8	2¼	8	2	8	2
33	7	2¾	8	1¾	7	11¼	8	0¾
34	8	0¼	8	1¼	8	1	7	11¼
35	8	4	8	0½	8	1	7	8¼
36	8	4	8	1½	8	1¼	7	8¼
37	8	4	8	2¼	8	0¾	7	9¾
38	6	1¼	8	1¼	7	8	7	8
39	18	10¾	8	1	7	8¾	7	10¾
1740	12	6	8	3¾	8	2¾	8	8
41	7	2¾	8	3¾	8	2¾	8	6¼

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE OATS,

Per Boll, containing 6 Bushels, 1 Peck, 1 Gallon, 0.3257 Pottle.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1742	6	8	8	2	8	2¼	8	3¾
43	5	10	7	11¾	8	0½	7	11½
44	7	2¾	8	0¼	7	11½	7	9¾
45	10	0	8	1¼	8	1½	8	4½
46	8	7¼	8	1½	8	1¾	8	3¼
47	7	6	8	0¾	8	0¾	7	7
48	7	11	7	11½	8	3	7	8¼
49	7	4	7	10¾	8	1½	7	9¼
1750	8	10	7	11½	7	8½	8	2½
51	8	4	8	0¼	7	9¾	8	4½
52	10	6	8	2¼	8	2½	8	5¼
53	10	0	8	4	8	7½	8	7½
54	8	4	8	4	8	8¾	8	9
55	8	10¾	8	4½	8	7½	8	11
56	11	8	8	6½	8	11¼	9	6
57	12	0	8	8½	9	4½	9	11½
58	8	9	8	10¼	9	5¼	10	0¼
59	7	8	8	9½	9	6	9	7½
1760	8	0	8	6¾	9	5	9	4
61	9	0	8	7¾	9	5¾	9	5
62	12	8	8	11½	9	8¼	9	11½
63	11	1¼	9	2½	9	9¾	9	10¾
64	11	8	9	5¼	10	1¾	9	10
65	13	4	9	7¼	10	7	10	6
66	14	0	9	10½	10	9¾	11	4¾
67	13	4	10	2	10	11½	12	2
68	10	6	10	3½	11	1½	12	4½
69	12	0	10	6¼	11	6¾	12	3¼
1770	12	6	10	8½	12	0	12	5¾
71	14	0	11	0	12	6	12	9¾

The FIARS of CLACKMANNAN-SHIRE—*continued*.

CARSE OATS,

Per Boll, containing 6 *Bushels*, 1 *Peck*, 1 *Gallon*, 0.3257 *Pottle*.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	13	0	11	1½	12	6½	12	9¼
73	13	0	11	3¼	12	8¾	12	7½
74	13	6	11	6¼	12	11	12	7¾
75	11	0	11	7¼	12	8¼	12	8½
76	10	6	11	7	12	4	12	6
77	10	6	11	6	12	0½	12	2½
78	11	6	11	7¾	12	1¾	11	10¼
79	10	0	11	9	11	11¼	11	5¼
1780	11	0	11	10¾	11	9½	11	1¾
81	11	6	12	0¼	11	6½	10	10¼
82	16	0	12	2¼	11	10¼	11	6¾
83	15	0	12	4¾	12	0½	12	2½
84	15	6	12	7	12	3	12	11¼
85	12	6	12	6½	12	4¾	13	0¾
86	14	0	12	6½	12	9	13	7¾
87	13	6	12	6½	13	0½	14	0
88	12	0	12	7½	13	1¼	14	0¾
89	13	6	12	8¼	13	5¼	13	8½
1790	14	8	12	9¾	13	9¼	13	8
91	15	0	12	10¼	14	2	13	7¼
92	14	6	12	11	14	2	13	10½
93	16	0	13	1	14	1¼	14	2
94	16	0	13	2½	14	2	14	6¼
95	20	0	13	3¼	14	11	15	8
96	17	0	13	7¼	15	2½	16	2
97	14	0	13	9¼	15	3¼	16	0¾
98	15	0	14	4	15	6¾	16	0¾
99	24	0	15	0¼	16	7½	17	5¼
1800	38	0	16	4½	18	11¼	20	6½
1	17	6	16	7½	19	2¼	20	9½

The FIARS of CLACKMANNAN-SHIRE—*continued.*

CARSE OATS,

Per Boll, containing 6 *Bushels,* 1 *Peck,* 1 *Gallon,* 0.3257 *Pottle.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1802	16	0	16	8½	19	4¼	20	2½
3	18	0	16	10½	19	6½	20	4¼
4	20	0	17	0¾	21	2½	19	11½
5	20	6	17	5½	20	0	22	0
6	22	0	17	10¼	20	6	21	8½
7	26	0	18	5¾	21	8¼	20	0
8	24	3	19	1	22	7½	20	11½
9	27	0	19	9¼	22	11	21	8
1810	21	0	20	1	21	2¾	22	11½
11	24	0	20	6½	21	10½	23	6½
12	30	0	21	2½	23	3¼	24	10¾
13	21	6	21	7	23	7	24	9¾

The FIARS of CLACKMANNAN-SHIRE—*continued.*

DRYFIELD OATS,

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1713	6	8	—		—		—	
14	8	4	—		—		—	
15	8	7¼	—		—		—	
16	6	1¼	—		—		—	
17	6	8	—		—		—	
18	7	2¾	—		—		—	
19	7	9¼	—		—		7	4
1720	6	8	—		—		7	4
21	6	8	—		—		7	1¾
22	8	10¾	—		7	4¼	7	1¾
23	8	4	—		7	6¼	7	5½
24	6	1¼	—		7	3¾	7	4½
25	7	6	—		7	2¼	7	5
26	6	11¼	—		7	3¼	7	3½
27	8	4	—		7	5¼	7	6½
28	9	2	—		7	7¾	7	10¾
29	7	9¼	—		7	7¾	7	8¾
1730	6	8	—		7	7¾	7	6
31	6	8	—		7	7¾	7	7
32	6	8	7	4¾	7	5	7	5½
33	6	8	7	4¾	7	3	7	5
34	7	6	7	4¼	7	4¾	7	3½
35	7	6	7	3½	7	4¼	7	0¾
36	7	6	7	4¼	7	5¼	7	0¼
37	7	1	7	4½	7	3¾	7	1
38	5	6¾	7	3½	6	11½	6	11
39	7	9¼	7	3¼	6	11½	7	1
1740	11	8	7	6½	7	5½	7	9½
41	6	6	7	6½	7	5¼	7	7¾
42	5	10	7	4½	7	4¼	7	5

The FIARS of CLACKMANNAN-SHIRE—*continued.*

DRYFIELD OATS.

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1803	17	0	15	8⅗	18	5⅕	19	4 1/7
4	19	0	15	11⅗	18	10⅕	20	1 3/7
5	18	0	16	5⅕	18	7⅘	20	7 5/7
6	20	6	16	10⅕	19	1⅕	20	3 1/7
7	25	0	17	4⅕	20	5⅕	18	8 6/7
8	22	6	17	11	22	3	19	6 3/7
9	25	0	18	6⅕	21	5⅕	21	1 5/7
1810	19	0	18	9⅕	19	9	21	3½
11	24	0	19	3⅕	20	6	22	0
12	29	0	20	0⅗	21	10⅘	23	6 5/7
13	21	0	20	4½	22	3½	23	7 3/7

The FIARS of CLACKMANNAN-SHIRE—*continued.*

MEAL,

Per Boll, containing 140 *lib. Avoirdupois.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1712	7	9¼	—		—		—	
13	8	4	—		—		—	
14	10	0	—		—		—	
15	10	0	—		—		—	
16	7	6	—		—		—	
17	7	9¼	—		—		—	
18	8	10¾	—		—		8	7¼
19	9	5¼	—		—		8	10¼
1720	8	4	—		—		8	10¼
21	8	4	—		8	7¾	8	7¼
22	10	0	—		8	10¼	8	7¼
23	10	6¾	—		9	1	9	0½
24	7	6	—		8	10	9	0
25	9	2	—		8	9	9	0½
26	8	10¾	—		8	10½	8	11½
27	10	0	—		9	1¼	9	2¼
28	11	1¼	—		9	4	9	7
29	9	5¼	—		9	4	9	6¼
1730	8	0¾	—		9	3½	9	2
31	7	9¼	8	11¼	9	3	9	2½
32	8	0¾	8	11½	9	0½	9	0½
33	8	4	8	11½	8	10	8	11¼
34	9	5¼	8	11	9	0¼	8	10¾
35	9	5¼	8	10¾	9	0¾	8	7¾
36	9	5¼	8	10½	9	1¼	8	7¾
37	9	2	9	0¾	9	0¼	8	9¾
38	7	9¼	9	0	8	8¼	8	9¾
39	10	0	9	0½	8	9	9	1
1740	16	8	9	5½	9	7¼	10	3¼
41	8	10¾	9	5¾	9	8¾	10	2¼

The FIARS of CLACKMANNAN-SHIRE—*continued.*

MEAL,

Per Boll, containing 140 lib. Avoirdupois.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1742	7	6	9	4¼	9	8	9	11
43	6	8	9	2	9	6	9	6¼
44	8	10¾	9	2¾	9	5¼	9	5¾
45	12	8	9	5	9	9¼	10	2¼
46	10	0	9	5½	9	9¾	10	2¼
47	8	4	9	4½	9	8¾	8	11¼
48	8	10¾	9	3¼	9	10¼	8	11¾
49	9	8	9	3	9	9¾	9	3¾
1750	10	0	9	4½	9	1¾	9	9¼
51	11	8	9	6¾	9	5	10	2
52	13	4	9	10	10	0	10	3¼
53	11	1¼	9	11¾	10	5½	10	5
54	9	6	9	11¼	10	6¼	10	7
55	11	1¼	10	0¼	10	4¼	10	10¼
56	14	4	10	3¼	10	9½	11	7
57	13	4	10	6¼	11	3½	12	0¾
58	9	7	10	7¼	11	4½	12	9
59	9	0	10	6½	11	3½	11	1¾
1760	9	2	10	2¼	11	2¼	10	10¼
61	10	0	10	3	11	0½	10	11¼
62	14	2	10	7	11	1½	11	4½
63	12	6	10	10¼	11	3¼	11	1¼
64	13	4	11	1	11	7¾	11	1¼
65	16	0	11	3	12	1¼	12	0¼
66	16	0	11	6½	12	3½	13	0¼
67	15	6	11	11	12	6¼	13	11
68	12	6	12	1½	12	9¾	14	3½
69	13	4	12	3¼	13	3	14	2
1770	13	4	12	5¼	13	8	14	3½
71	15	6	12	7½	14	2¾	14	7

The FIARS of CLACKMANNAN-SHIRE—*continued.*

MEAL,

Per Boll, containing 140 *lib. Avoirdupois.*

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	16	0	12	9¼	14	4¾	14	7
73	16	0	13	0	14	9	14	7
74	15	6	13	3¾	14	11¾	14	7
75	12	6	13	4½	14	7½	14	7
76	12	0	13	3	14	2¾	14	4¾
77	12	0	13	2¼	13	10½	14	2½
78	12	0	13	3¾	13	9¾	13	8½
79	10	8	13	4¾	13	6¾	12	11½
1780	13	4	13	7¼	13	8¾	12	6¾
81	12	4	13	8¾	13	2¾	12	1½
82	18	8	13	11¾	13	6	13	0
83	16	0	14	1½	13	6	13	6¾
84	16	0	14	3	13	6¾	14	1¾
85	13	4	14	1½	13	7	14	4¼
86	15	4	14	1¼	13	11¾	15	0¼
87	14	8	14	0¾	14	3	15	2½
88	12	8	14	0¾	14	3¾	15	3
89	14	0	14	1¼	14	7¾	14	7
1790	15	4	14	2¼	14	10¼	14	6
91	15	4	14	2¼	15	1¾	14	4¾
92	16	0	14	2¼	14	10¾	14	9
93	16	8	14	2¾	14	11½	14	11½
94	16	8	14	3¼	15	0¼	15	2¾
95	20	8	14	9	15	8¾	16	4½
96	17	4	15	0	15	11¼	16	10¼
97	16	0	15	1¼	16	0¾	16	11½
98	16	8	15	4¾	16	5½	17	1¾
99	20	8	16	3¼	17	11	18	11
1800	42	0	18	2½	20	6¼	22	6½
1	19	0	18	6½	20	11¼	22	10¼

The FIARS of CLACKMANNAN-SHIRE—*continued.*

PEAS,

Per Boll, containing 4 Bushels, 1 Peck, 1 Gallon.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1742	7	1	8	2¼	8	8¾	9	4½
43	5	5	7	10¾	8	7½	8	10½
44	5	10	7	10½	8	6½	8	5
45	11	8	8	1	8	10¼	9	3
46	8	9	8	2	8	9¾	9	2½
47	6	0	7	11½	8	6¾	7	8
48	7	0	7	9½	8	7¼	7	4¾
49	6	3	7	8¾	8	4½	7	3¼
1750	10	6	8	0¼	7	8¾	8	0
51	10	0	8	2½	7	11¼	8	7
52	12	8	8	6¾	8	4¼	8	8¼
53	10	0	8	8¾	8	10¼	8	11
54	7	8	8	9½	9	0½	9	1¾
55	10	0	8	10½	8	10½	9	7
56	12	6	9	0½	9	3	10	5¾
57	15	6	9	4¼	10	2½	10	2½
58	7	6	9	5½	10	3½	10	10
59	6	8	9	4	10	3½	9	11¾
1760	8	10	8	11¼	10	1½	9	9¾
61	8	8	8	11	10	0	9	11½
62	13	4	9	2¾	10	0¾	10	5
63	12	6	9	7	10	3¾	10	5
64	13	4	9	11½	10	10½	10	1½
65	16	8	10	2½	11	6½	11	5
66	15	0	10	6¾	11	9½	12	7½
67	15	0	10	11¾	11	9	13	6
68	9	6	11	1¼	11	11¼	13	7½
69	12	0	11	4¾	12	5¾	13	5
1770	12	6	11	5¾	12	10¼	13	5
71	13	4	11	7¾	13	2¼	13	5

The FIARS of CLACKMANNAN-SHIRE—*continued.*

PEAS,

Per Boll, containing 4 Bushels, 1 Peck, 1 Gallon.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	15	0	11	9¼	13	5¾	13	2¼
73	12	6	11	10¾	13	5¾	12	10
74	14	0	12	2½	13	6½	12	8¼
75	11	6	12	3½	13	0¼	12	11¾
76	10	6	12	2¼	12	7	12	9
77	10	0	11	11	12	1	12	4¾
78	9	0	11	11¾	12	0¼	11	9½
79	8	6	12	1	11	8¼	10	10¼
1780	9	6	12	1¼	11	4½	10	5
81	12	0	12	3¼	11	3	10	1¾
82	18	0	12	6¼	11	6½	11	0¾
83	14	0	12	6½	11	8¼	11	6¾
84	13	6	12	7¼	11	7¾	12	0¾
85	11	6	12	4	11	7¾	12	5
86	14	0	12	3½	12	0	13	2½
87	11	6	12	1¼	12	1¾	13	6
88	12	0	12	2¾	12	5¼	13	6
89	18	6	12	6¾	13	5¼	13	6¾
1790	12	6	12	6¾	13	9	13	4¼
91	13	4	12	6¾	13	10½	13	4
92	14	0	12	5½	13	5¾	13	8¼
93	14	0	12	7	13	5¾	13	8
94	15	0	12	7	13	7½	14	2¼
95	20	0	13	1¼	14	5¾	15	4
96	15	0	13	4½	14	7	14	10
97	15	0	13	7	14	11¼	15	2¼
98	13	0	13	9¼	15	1	15	2½
99	26	0	14	7¾	15	10	16	11¼
1800	47	0	16	6¼	19	3¼	21	7¾
1	18	0	16	9¼	19	9	22	0¾

THE FIARS of CLACKMANNAN-SHIRE—*continued.*

PEAS,

Per Boll, containing 4 Bushels, 1 Peck, 1 Gallon.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1802	17	0	16	8¼	20	0½	21	7¾
3	18	0	16	8½	20	5¼	22	0¾
4	19	0	17	0	20	10¼	22	7½
5	19	0	17	7¼	20	9	23	5
6	20	0	17	11	21	3	22	6¾
7	31	0	18	10¾	22	10½	20	3¾
8	32	0	19	10¾	24	8¼	22	3½
9	27	0	20	3¾	29	9½	23	8½
1810	20	0	20	8¾	22	1¾	24	0
11	28	0	21	5	23	1¼	25	3½
12	32	0	22	3¼	24	7¼	27	1¾
13	22	0	22	8¼	25	0	27	5

The FIARS of CLACKMANNANSHIRE—*continued.*

MALT,

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	d.	s.	d.	s.	d.	s.	d.
1712	8	4	—		—		—	
13	8	10¾	—		—		—	
14	11	1¼	—		—		—	
15	10	6¾	—		—		—	
16	8	4	—		—		—	
17	7	9¼	—		—		—	
18	8	4	—		—		9	0½
19	8	10¾	—		—		9	1½
1720	8	4	—		—		9	0½
21	8	4	—		8	10¾	8	7¾
22	10	0	—		9	0¾	8	6¾
23	10	6¾	—		9	2¼	8	10½
24	8	4	—		8	11¼	8	11½
25	8	10¾	—		8	9¼	9	0½
26	8	4	—		8	9¼	8	11½
27	11	8	—		9	2	9	5¼
28	12	6	—		9	7	10	0½
29	9	4	—		9	7½	9	11¼
1730	8	4	—		9	7¾	9	7½
31	8	0	9	2¾	9	7	9	7
32	8	4	9	2¾	9	5½	9	6
33	9	2	9	3	9	3½	9	7½
34	9	5¼	9	2	9	4¾	9	3½
35	10	0	9	1¾	9	6	8	11¼
36	10	10	9	3¼	9	9¼	9	1¾
37	10	0	9	4½	9	7	9	4¾
38	9	2	9	5	9	3	9	6¾
39	11	1¼	9	6½	9	5¼	9	11½
1740	16	8	9	11½	10	3¼	11	0¼
41	9	2	9	11¾	10	4¾	10	11¾

The FIARS of CLACKMANNAN-SHIRE—*continued.*

MALT,

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1742	9	2	9	11¼	10	5¾	10	10½
43	8	4	9	10	10	4¾	10	6¼
44	8	10¾	9	11¼	11	4	11	9½
45	12	2¾	10	0¾	11	6¾	12	2¾
46	12	2¾	10	3	11	8¼	12	4½
47	10	0	10	2	11	8¼	11	5
48	9	4	10	0	11	8½	11	5½
49	9	2	10	0	11	6¼	11	5½
1750	10	6	10	1¼	10	10¾	11	9
51	12	1	10	3¾	11	2¼	10	9½
52	12	9¼	10	6½	11	6½	10	10½
53	12	6	10	8½	11	11½	10	11
54	9	4	10	8¼	11	0¾	10	9¾
55	11	1¼	10	9	10	10¾	11	0¾
56	16	0	11	0	11	3¼	12	0½
57	16	8	11	6	11	11¼	12	11
58	10	6¾	11	5	12	0¾	12	8½
59	9	5¼	11	4	12	1½	12	2¼
1760	11	1¼	11	0½	12	1¾	12	0½
61	11	8	11	2	12	1¼	12	4½
62	15	0	11	5½	12	4	12	11
63	15	0	11	9½	12	7	12	9¼
64	16	0	12	1½	13	3	12	8¼
65	19	4	12	6¼	14	0¾	13	11
66	18	4	12	9¾	14	4	15	2½
67	17	6	13	2¼	14	4¾	16	1½
68	14	0	13	4½	14	8¾	16	5½
69	16	0	13	3¼	15	4¾	16	7¼
1770	16	8	14	1	15	11¼	16	10
71	16	8	14	3¾	16	5¼	16	11¼

The Fiars of Clackmannan-shire—*continued.*

MALT,

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1772	19	0	14	7½	16	10¼	16	10½
73	19	0	14	11¼	17	3	16	11¾
74	19	0	15	5	17	6½	17	2¼
75	17	0	15	8¾	17	3¾	17	7½
76	14	0	15	7½	16	10½	17	4
77	15	0	15	6½	16	7½	17	1¼
78	14	6	15	8¾	16	8¾	16	9½
79	14	0	15	11½	16	5¾	16	0¾
1780	16	6	16	2¾	16	5½	15	8½
81	17	0	16	6	16	6	15	5¼
82	25	6	17	0¼	17	1¾	16	7¾
83	21	6	17	4	17	4¾	17	8½
84	21	0	17	7¼	17	7¼	18	6¼
85	17	0	17	5¾	17	7¼	18	11¾
86	19	0	17	6¼	18	1¼	19	7¾
87	19	0	17	7	18	6	20	0
88	16	6	17	8½	18	8¼	19	11¼
89	19	0	17	10¼	19	2¼	19	0
1790	19	0	17	11¾	19	5¼	18	7¾
91	22	6	18	3¼	20	0	18	10¼
92	23	0	18	5¾	19	9	19	8
93	23	0	18	8	19	10¾	20	3¾
94	25	0	18	11¾	20	3½	21	1¾
95	27	6	19	6	21	4¼	22	8½
96	28	0	20	2¼	22	3	24	0
97	20	0	20	5¼	22	4¼	24	1¾
98	20	0	20	8¾	22	8¼	23	9½
99	32	0	21	7¼	24	0	25	0¾
1800	47	0	23	1½	26	9½	28	6
1	33	0	23	11	27	10¼	29	7½

The FIARS of CLACKMANNAN-SHIRE—*continued*.

MALT,

Per Boll.

Crops.	Annual Price.		20 Years Average.		10 Years Average.		7 Years Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1802	25	0	23	10¾	28	0½	29	3½
3	35	0	25	6½	29	3	30	3½
4	50	0	27	2¼	31	9	34	6¾
5	44	0	27	4½	33	4	38	0
6	44	0	28	7½	35	0	39	8½
7	46	0	29	11¾	38	2¼	40	5
8	50	0	31	7¾	40	7¼	42	0
9	50	0	33	1¾	42	4¾	45	6¾
1810	52	0	34	10¾	42	10¾	48	0
11	58	0	36	9½	45	4¾	49	1¾
12	60	0	38	8	48	10¾	51	5
13	52	0	39	11	50	7¼	52	6¾

Chap. XVI. App. No. 10.

On Benefit Societies.

By Sir John Sinclair.

The advantages resulting from Benefit Societies need not be dwelt upon, being so generally admitted. Their tendency to promote good conduct among the lower orders of society, whilst they encourage at the same time that independency of spirit, so desirable in a free country, and so favourable to virtuous habits, can hardly be questioned; and the prospect they hold forth of diminishing the heavy burden of the poor-rates in England, and preventing any risk of their establishment in Scotland, are objects, in a national point of view, of infinite moment. If Benefit Societies could likewise be rendered serviceable in maintaining the public credit of the country, the advantages to be derived from such institutions would be incalculable. The outlines of a plan for that purpose, it may be proper briefly to explain.

All plans hitherto adopted *for the extensive establishment* of Benefit Societies, have been too often unsuccessful, on the following accounts.

1. The money paid has been often embezzled, which checks much a spirit for entering into such institutions. 2. The money is not accumulated with the rapidity which it ought to be; and, 3. The plans of such institutions have often been founded on erroneous principles.

1. In order to remedy the first objection, the money, as soon as paid by the contributors, ought instantly to be remitted to London, and invested in the Funds. Through the medium of the Excise-office in Edinburgh, in conjunction with the collectors in the country, there is no difficulty in receiving at, or remitting to, London, such trifling sums as a few shillings paid on account of soldiers or sailors, or their wives and families. Through the same channel, the funds of the Benefit Societies might be remitted, and any sums transmitted back again when necessary.

For managing these concerns in London, an office may be necessary, to invest the money in the Funds, and to correspond with the Excise establishments in the country, regarding both the funds of the Societies remitted, and the payments required, whose correspondence would, of course, be duty free, being a public establishment.

2. It is evident, that by following this plan, the funds of the Societies might be accumulated at compound interest, *half yearly*, which is but rarely done at present, at least in country districts; and which would enable them much better than otherwise would

be the case, to grant beneficial terms to the contributors, and to fulfil their engagements.

3. It would require much consideration and inquiry, to point out the best plans for Benefit Societies, so as to be generally applicable to the whole kingdom; and a good deal of latitude must be given, that they may be suited to the circumstances of each particular district. Some idea, however, may easily be given, if these hints are approved of, to prevent those visionary plans of *impracticable benefit*, which can only terminate in disappointment.

If these general outlines were adopted, the result probably would be,

1. That every industrious man in the kingdom, might, by a moderate sacrifice, secure a comfortable provision for himself, in sickness and old age, and for his wife, if she survives him.

2. That there would be a constant remittance of money to London, to purchase stock; a large proportion of which would remain undemanded, and by means of which, the price of the Funds, that barometer of public credit, would be kept up. And,

3. That all the industrious classes of the community, would thus be interested in the preservation of the Government, and in the prosperity of the country.

In regard to Benefit Societies in Scotland, several have been established in various parts of the kingdom; but there is none where a better system, or more useful rules have been adopted, than at Castletown in the county of Caithness; and on that account they are annexed to these observations.

REGULATIONS OF THE SOCIETY OF UNITED FARMERS AND CRAFTSMEN OF CASTLETOWN IN THE COUNTY OF CAITHNESS.

At Castletown, the 14th February 1798, and the 38th year of the Reign of His Majesty King George the Third, whom God long preserve.

We, the farmers and craftsmen, in and about Castletown, having met, it was proposed, and unanimously agreed to, that it is expedient and necessary for us to form ourselves into a Society, and to raise a fund for the aid and assistance of such members, their widows and offspring, whom it may please God to reduce to indigence and want. We, therefore, resolve to unite ourselves into a Society, which shall be known, and called, by the name of the UNITED FARMERS AND CRAFTSMEN OF CASTLETOWN, for the ends and purposes aforesaid: And further, we bind and oblige ourselves to abide by the following rules and regulations, and such others as may hereafter be judged proper to adopt.

Article I. *Admission of Members.*

1. That no person is to be admitted into the Society but he who is a Protestant by profession, and of a good moral charac-

ter, sound in mind and body, and to all appearance able to provide for himself and his family.

2. That at the commencement of the Society, persons be admitted at the age of 60; but after the Society amounts to 100 members, no person shall be admitted above the age of 40 years.

3. That no person shall be admitted into the Society as a member, until he is recommended at least by two members of the Society, with whom he has been acquainted for a sufficient time before, and until he is personally present, unless for reasons satisfactory to the Society.

4. That sons of members, of the aforesaid description, be admitted after the expiration of six years from the commencement of the father, upon paying half entry money, provided their age does not exceed 30 years.

5. If a member has no son, his son-in-law shall have the same privilege.

6. That notwithstanding the said regulations, no person shall be admitted without the voice of a majority of the members of the Society.

II. *Times of Meeting.*

1. That the Society shall meet on the second Wednesday of February, May, August, and November, annually, during the existence of the Society.

2. That the Society shall meet at twelve noon, on the February meeting, which shall be deemed the annual meeting, for the election of office-bearers and other business; and at noon on the other quarterly meeting days.

III. *Election, and Duty of the Office-bearers.*

1. That a member shall be chosen annually, by a majority of votes, to bear the office of Preses, who shall maintain good order, take the sense of the meeting, and sanction their resolutions by his subscription; and also choose a depute to officiate in his absence.

2. That a member shall be chosen annually to bear the office of Treasurer, who shall pay the sums allowed weekly to each sick, superannuated, or otherwise indisposed member, and account for the same next quarterly meeting thereafter.

3. That four members shall be chosen annually as Stewards, to bear office quarterly, in rotation; and the Steward for the quarter shall visit each sick or otherwise indisposed member within a mile and a half of Castletown.

4. That four members shall be taken from the roll quarterly, to bear office as Managers, who, together with the other office-bearers, shall be a Committee, to determine in all causes that may occur between the quarterly meetings, not provided for in the Articles: but their determination shall be no longer binding

than the first quarterly meeting, unless sanctioned by the Society.

5. That a member shall be chosen annually to the office of Clerk, who is to attend all the meetings of the Society and Committees.

IV. *Collections.*

1. That during the first year of this Society, each person admitted shall pay, as entry-money, five shillings Sterling; but after that period, it shall be in the power of the Society, to raise the entry money from time to time, as shall be thought proper.

2. That each member shall pay 1s. quarterly, as quarter pennies.

3. That in case the fund of the Society, by sick members' annuities, or otherwise, should be brought to the sum of ninety pounds Sterling, each member shall pay in proportionally, over and above the ordinary quarter pennies, until the fund shall exceed that sum as much as the Society shall deem needful.

4. That at the death of a member, or members, within the space of six years from the commencement of this Society, each member shall pay in his respective share of what sum may be given out for the interment of the aforesaid member or members.

5. That any member residing in England or Ireland shall be allowed two years and a half to remit his quarterly payments, without any fine.

6. That any Member leaving Great Britain and Ireland, will be allowed six years to remit his quarterly payments, without a fine.

7. That members residing in Scotland, and not in Caithness, will be allowed eighteen months to remit their quarterly payments, without any fine. Members in Caithness, at ten miles distance, to be allowed one year to remit their quarterly payments, without fine.

V. *Fund.*

1. That all, or part of this fund, shall be laid out, if required, in purchasing any commodity that may be for the joint interest of the members, or given out on lawful interest, until the next annual meeting.

2. That no more than twenty pounds Sterling shall be given out to any one member at one time.

3. That no member shall receive any sum upon interest until he finds two cautioners, and both of them satisfactory to the Society.

VI. *Box.*

1. There shall be a box with three locks, and three keys, different from one another, to hold the money, books, bills, or other papers belonging to the Society.

2. That two keys shall be kept by two of the Stewards, each quarterly, and the other by the manager for the quarter; the box to be deposited in the Treasurer's house.

VII. *Benefit.*

1. That any member who is rendered unfit to provide for himself and family, by sickness, accident, or otherwise, shall receive three shillings Sterling per week for the space of six weeks; and if he is not likely to recover, shall receive two shillings Sterling for other six weeks, if so long sick.

2. That any member continuing sick for more than three months, and in all human probability not likely to recover; or, having failed through old age, or infirmity, shall be put upon the superannuated list, and receive fifteen shillings Sterling quarterly, or their proportions paid weekly, as the Society shall see cause.

3. That every widow of this Society shall receive *two thirds* of the superannuated members' allowance; and that paid quarterly.

4. That if a member die before his widow is entitled to the annuity, she shall continue the quarterly payments until she is entitled to the annuity, and then she shall receive as formerly stated.

5. That orphan children of deceased members shall receive ten shillings Sterling yearly, less or more, as the Society shall deem fit, until they arrive at ten years of age.

6. That a member's widow marrying, her annuity shall be immediately withdrawn; and if there be any children of the first marriage, who shall appear to be in indigent circumstances, they shall receive the orphan's annuity.

7. That on the death of a member, 1*l.* 15s. shall be paid from the fund of the Society; and on the death of a member's widow, 1*l.* Sterling, for defraying funeral charges.

8. That members not residing within one mile and a half of Castletown, shall attest their claims on this Society by two satisfactory members; or in failure of that, by the minister and one of the elders of the parish they reside in.

VIII. *No Benefits.*

1. That no money shall be paid out from the fund until the capital amounts to 120*l.* Sterling.

2. That no member shall receive any benefit until his name shall have been six years on the roll.

3. That any member in arrears to this Society shall not receive any benefit until the same is regularly paid up.

4. That any member who shall bring disease on himself, by any unlawful means, shall not receive any benefit while thus indisposed.

5. That any member who shall waste, or destroy any part of the Society's funds, by pretended sickness or otherwise, shall be expelled the Society.

6. That if any member fails to pay in his quarterly payments for three quarters successively, and not appearing, or sending, the fourth quarter day before the books are shut, his name shall be struck off the roll, unless two-thirds of the Society shall declare in his favour.

7. That any member who shall curse, swear, or take the *Divine Name* in vain, while in this Society, shall be reproved by the Preses; and provided he continues in such practices, he shall be expelled the Society.

8. That if any member come into the meeting intoxicated with liquor, so as to occasion any quarrel, or be troublesome in the meeting, he shall be reproved by the Preses, and fined; and if he continues in such practice, he shall be expelled the Society.

9. If any member be found guilty and convicted of any enormous crime, in any of his Majesty's Courts of Justice, he shall, upon such conviction, be immediately expelled the Society; and if he should happen to leave a widow or children, whose necessity may call for assistance, they shall be referred to the generoty of the Society.

IX. *Fines.*

1. That if a Preses refuses to bear office after he is duly elected, he shall pay a fine of 2s. Sterling; a Treasurer 1s. 6d.; a Steward 9d. of fine.

2. That if the Preses, and all those holding office, are not present within half an hour of the time appointed for the meeting, he or they so absent shall pay a fine of 6d. each.

3. That if a member, residing within ten miles of Castletown, is absent from the yearly meeting of the Society, he or they shall pay a fine of 6d. each.

4. That if a member fails to pay, or send his quarterly payment, he shall pay a fine of twopence for the first quarter, threepence for the second, and fourpence for the third quarter.

5. That if a Steward for the quarter fail to visit the sick, or otherwise indisposed member, residing within the limited distance, weekly, within forty-eight hours after notice is sent to him, he shall pay a fine of sixpence for each offence.

6. That on the death of a member, or a member's wife or widow, any member failing to attend his or her funeral, when duly warned, and residing within two miles of the deceased, shall pay a fine of sixpence.

7. No member shall be allowed to speak in the meeting but upon the business thereof, after the books are opened, until they are shut, under the penalty of a fine of sixpence for each offence, nor direct his discourse to any of the brethren, while they

are engaged in the business of the meeting, but to the Preses. Neither shall more than one person speak at one time, so that one may not interrupt the other, or occasion confusion: such offence to be determined by the meeting, and the offenders liable to what penalty they may inflict.

8. That any member may deliver his opinion respecting the business of the meeting at the time under consideration, and that with freedom and impartiality, and speak or be silent as the Preses shall direct.

9. That if any member be found a backbiter, talebearer, or busy body, and shall privately inform against any of his brethren of the Society, concerning any matter that shall happen in a meeting, which shall be prejudicial to them, or any individual among them, or which might occasion any quarrel; and, in particular, any member who shall inform against another voting in opposition to a member who is absent, such informer or informers shall forfeit a penalty of 2s. 6d. for the first offence, 3s. for the second, and, if he continue such practices, shall be expelled the Society.

10. That if any member refusing to pay a fine, on conviction, his money shall not be received, nor he any longer accounted a member, unless a majority of the Society declare in his favour.

X. *Of the Society in general.*

1. The Society being composed of members of two professions, viz. Farmers and Craftsmen; therefore, to prevent all disputes or grumbling that might hereafter arise, in disposing of the money of this Society to members, it is hereby resolved upon, that it shall be proportioned between the two professions, and laid out accordingly, if required; and, if not required, that it shall be laid out as formerly specified.

2. That it shall be in the power of the Society to make or add new articles, and alter or amend those already made, as they may see necessary; but such new articles or amendments shall not be in force, until passed into a law, in a yearly full meeting of the Society.

3. That no less than two thirds of this Society can be a majority, sufficient either to make, alter, or amend any of the articles already made, or to dispose of any of the funds of the Society: but in choosing office-bearers, or any small matter, a majority of *one* shall be sufficient.

4. It is hereby expressly declared and agreed upon, that the said fund shall always remain at Castletown, and that at least four members, managers of the fund, reside in, or within one mile of, the village. That the box shall not be broken up, nor the money shared or divided, so long as five members shall remain, and hold it a Society. If any member in or out of the

place, mention the breaking of the Society, he shall, upon full proof and conviction thereof, be excluded the Society.

5. If any doubt shall arise with respect to the meaning of these articles, the sentiment and judgment of a majority of the Society shall determine the point.

GEORGE BRUCE, Preses.
DAVID BAIN, Clerk.

[Then follows the certificate of the clerk of the peace, that the said articles were read in presence of, and approved by the Justices of the shire of Caithness, at their general quarter sessions.]

CHAPTER XVII.

APPENDIX.

OF THOSE OBSTACLES TO IMPROVEMENT WHICH ARE LOCAL, AND CHIEFLY LIMITED TO THE HIGHLANDS AND ISLANDS OF SCOTLAND.

By the Rev. DR RENNIE.

THE greatest obstacle to the improvement of the Highlands and Islands of Scotland, arises from the climate. This occasions often a late seed-time, and a late harvest; and though there were both good horses and good ploughs in the Highlands, yet, on an average of seasons, little more than one half the land can be ploughed by a pair of horses, that is done in the Lowlands. The rigours of the climate however, cannot be removed, but they may be alleviated by enclosures, hedges, and getting frequent changes of early kinds of seed from the Low Country.

SECTION I.

The obstacles which it is more in the power of man to redress, shall be more fully dwelt on.

I. *The Tenure of Land in those Districts.*

In every country, the state of agriculture depends very much on the tenure by which the land is held by those who cultivate it. In the Highlands and Hebrides, there are a variety of ways, by which tenants hold their farms, peculiar to that part of the kingdom; and, in as far as they are peculiar, they operate as obstacles to the general improvement of these districts. For in no one of these respects do they excel other parts of Scotland, more favourable for cultivation, or better improved. On the contrary, in as far as they differ, they are deficient. As a proof of this, it is only necessary to point out the peculiar tenures that prevail over the Highlands and Western Isles.

In general, there are three ways in which the land is possessed: 1. by Tacksmen; 2. by Tenants; and, 3. by Subtenants. The tacksman holds his land immediately from the proprietor, by a lease, like tenants in other parts of the kingdom. As he is generally of superior education, talents, and rank, to the rest of the inhabitants, and as he holds his lease for the most part for a considerable number of years, he may be a most useful member of society, as he has it in his power to promote the improvement of the land which he rents from the proprietor. But the tenants or small farmers are of a lower class. They hold their possessions at the will of the landlord, or of the tacksman, without any lease.

The subtenants are still inferior to these. They hold their possession, not from the landlord, nor always from the tacksman, but more generally of the tenant. Yet this last description constitutes the great bulk of the inhabitants of the Highlands of Scotland. They are all tenants at will. They have no lease; but lie at the mercy of the tacksman or tenant.

This mode of setting and subsetting of land, is one great and general bar to the improvement of the Highlands and Isles. It is a relic of the feudal system, utterly inconsistent with the interest of the landlord, the tenant, or the state. Hence many of the generous and enlightened proprietors of these districts have already abolished all such tenures.

One of them, who has, since that time, signalized himself in the service of his king and country, said very handsomely. 'During my father's lifetime his tenants had no will but his. They 'saw with his eyes, and heard with his ears; for they were all 'tenants at will. But I thank God I have not one tenant but 'now feels himself an independent man, and would go to law 'with me for half a crown.'

Besides the tenures, properly so called, the agriculture of the Highlands is injured by the privileges annexed to the different

Allotments of Land.

A very ancient valuation of land is still adhered to in a part of the Western Islands and Highlands. By it the whole district was divided into shilling, six-penny, and three-penny lands, Scotch money. According to the English denomination of money, they are termed penny, halfpenny, and farthing lands.

The possession of these lands is regulated by this old valuation. A large farm, which is held by a tacksman, contains sometimes twenty or thirty of these penny lands, or upwards. But a number of tenants frequently occupy a farm *jointly*. Some have a penny, others a halfpenny, and some only a farthing land. Whatever be the *real* value of the arable land, each has his cattle *soumed* and *roumed*, as it is called; *i. e.* proportioned to this valuation.

A common herd of cattle, thus kept on the same spot, and a farm thus cultivated, cannot be profitable or productive. On the contrary, such a tenure is an effectual bar to the improvement, either of the breed of cattle, or the cultivation of the soil.

Besides the bad proportions of pasture to particular allotments,

Township Possession,

Is another species of tenure, still more hurtful to agriculture.

In place of each tenant having a house on a distinct farm, a group of little huts are huddled together, like a rustic village. In this a number of tenants and cottagers reside. The land around them is also held in common by them all. The pasture land is the common field where all their cattle browse. The arable land is sometimes cultivated and cropped in common also, and the produce divided among them.

This is one of the most ancient customs in our country. It is a relic of the pastoral age, or feudal system. But it is ruinous to the interest of the landlord, the tenant, and the public, in the present enlightened state of agriculture.

Where lands are not possessed in Townships, they are too generally so in

Run-rig.

This mode of occupying land, originated from the same source. It is the natural result, and doubtless was meant as an improvement of the former plan. In place of the arable land being possessed, cultivated, and cropped, as a common field, each has a lot or strip allotted to him. Sometimes, in place of one, he has two, or more, especially if that arable land be of unequal value. In this case, he has a strip of the best in one part, and of the worst in another.

In the feudal age, this species of holding prevailed over a great part of Britain, perhaps of Europe. Cæsar mentions, that it was the customary practice among the ancient Gauls; and formerly it was attended with obvious advantages to all parties. To the landlord: for, by having his tenants and retainers thus crowded together in clusters, they were ready at his call to defend his person or property, on every emergency. From similar motives, many of the noblemen in England, Scotland, and Ireland, have their residence still in the vicinity, and sometimes in the middle, of a village; especially in Ireland. To the tenants themselves: for each was provided with pasture for his cattle, and a part of a farm for a crop of grain. And before land was enclosed, the possession of each was secured, by being intermixed with that of his neighbour. For it became equally the interest of all, to protect all. But now that every man, from the peer to the peasant, is under the protection of equitable laws, and that arable land is enclosed, cultivated, and cropped, in a manner, by which it becomes tenfold more productive, such practices are not only unnecessary, but destructive, proving a ruinous bar to every species of agricultural improvement. Yet they still prevail over too great a portion of the Highlands and Hebrides.

Owing to the poverty of the farmers, in some places,

Steel-bow still prevails.

This is a species of subset of a farm, which is practised by either the landlord or tacksman. Along with the land, he lets the whole stock of cattle upon it. In this case, that stock is valued; and at the expiration of the lease, the subtenant must either produce a stock in the same condition, or pay in value the balance. This is called Steel-bow; or a farm let in steel-bow.

By this sort of agreement, the subtenant pays two, or sometimes three rents for the farm, besides a high or usurious interest for the small capital, or value of live-stock, lent to the small farmer.

Half foot,

Is another method of occupying a farm, equally barbarous in itself, and adverse to improvement. It is not so prevalent in the Highlands as in some of the Western Isles. Dr Walker says that it is, however, practised in Skye and the neighbouring counties.

In this case, the possessor furnishes the land, and the seed-corn. The other party ploughs, sows, and harrows it. The crop in harvest is then divided between the proprietor and tenant. Under these circumstances, it is clear that the interest of the landlord, and the improvement of the soil is overlooked by both these parties. The object both of the possessor and the labourer of the soil, is to reap as much IMMEDIATE profit as possible.

II. *Stipulations in Leases, and Servitudes, and Casualties, peculiar to the Highlands and Hebrides, prove a great obstacle to improvement.*

Most of these were originally imposed of necessity, or even from benevolent motives on the part of the proprietor. The proprietor was always resident, the farmer had not money, but could easily pay his rent either in kind or by servitude.

Payment in Kind.

This was a practice which long ago prevailed over all Scotland; and it still exists in a great part of the north of Europe; in Russia and Sweden more especially. For similar reasons it is still retained over a considerable portion of the Highlands and the Isles. In place of a fixed rent in money, a part of the produce of the farm, *i. e.* of grain, &c. is paid to the proprietor.

In the present situation of the Highlands and Hebrides, such stipulations are oppressive to the tenant, and injurious to the landlord. The population of these districts is now increased to such a pitch, that they cannot supply themselves with the necessaries of life. The produce of few farms, in grain, is adequate to the immediate wants of the tenant and his servants.

As the causes which gave origin to such stipulations have ceased, the custom itself ought also to be abolished. Accordingly it has been on the decline for many years. In many instances, these stipulations have been converted into money; and it is hoped that this will soon become general.

Services.

In the Highlands and Hebrides, the services exacted by landlords from their tenants, are frequently numerous and burdensome; so that they become a great, and often an insurmountable, obstacle to all improvement. In some cases, every kind of labour that can be performed by men or horses, at any period of the year, even in seed-time and harvest, is exacted from the tenants.

They are frequently bound to plough and harrow the proprietor's farm, and to plant his potatoes, at the critical season of spring, when all their hands and horses are required at home: To work at his hay, and cut his peats in summer; and in the busy season of harvest to help him in with his crop: In short, to execute every sort of labour which a farm requires.

The tacksmen likewise generally require similar services from subtenants. In such a state of subjection, all parties must suffer, and every species of improvement be totally at a stand. While the tacksman is called off from the labours of seed-time, summer, and harvest, the task he performs to his landlord must ever be performed with a grudge. His vassals must be equally reluctant in doing such services to him, at the risk, and perhaps the ruin, of all their own little crop.

III. *Want of proper Accommodation for their Cattle, is a great Obstruction to the Improvement of the Highlands and Hebrides.*

From the high rents paid by the farmers in the improved districts, they are allowed proper accommodation for their families, their servants, and also for their cattle. It is otherwise in the Highlands and Hebrides. Many of the tenants inhabit miserable huts. And in most cases, no accommodation, and no shelter, is provided for their cattle in winter.

The consequences of this are obvious. Many of their cattle literally perish, for want of shelter, during the severity of winter; and all the stock of every kind are permitted to roam at large all the year round. By this means, all the low land, which is the best and most productive, is utterly ruined by poaching, and rendered much less productive.

Sheep farmers in the South of Scotland, have found that a bare wall, built in a circular form, on any eminence, sufficiently protects their flocks, by night, from being overlaid with snow: Besides, it saves the trouble and danger to which the poor shepherd is exposed, in watching his flocks by night, amid the horrors of the winter storm.

Better accommodation, therefore, for horses, milch-cows, and the young cattle, is absolutely requisite in the Highlands and Hebrides. The want of this is a great obstacle to the improvement of these districts.

IV. *The Want or Scarcity of Winter Food for their Cattle.*

In the cultivated districts of Scotland, where there is a great proportion of arable land, it is easy to supply the whole stock of cattle kept during winter. In the Highlands and Hebrides, it is otherwise. From the abundance of grass, ten times as many cattle may be reared and fed in summer, as can be kept alive in winter; and, for the most part, many more are retained during that season than can be tolerably fed. The consequences of this are frequently fatal to the stock, and ruinous to the farmer. When a severe winter, and heavy fall of snow ensues, one third, and sometimes one half of the whole stock perish for want of food. Even those which survive the storm, are so enfeebled, that they do not recover in time to be ready for the market; or, if offered to sale, they must be sold at reduced prices.

V. *Overstocking their Farms, is another Obstacle to the Improvement of the Highlands and Hebrides.*

Where abundance of food can be raised from any farm, it may, and ought to be consumed by cattle: But where little provision, except pasture, can be procured in winter, every farm of this description should be lightly stocked.

Yet it appears, from the Agricultural Reports of the Highlands and Hebrides, that the pernicious practice of overstocking almost every farm, with every species of live stock, generally prevails.

The number of horses kept for labour, is uniformly one-third more than is requisite for that purpose. This is, indeed, partly owing to the diminutive size of the animals used, and partly to their want of docility, or not being properly trained. A number of these stubborn animals is frequently yoked in one plough.

Dr Walker, in his posthumous work, remarks, that "the number of horses upon *every Highland* farm, is by far too great. They are so numerous, because they are inefficient. They are inefficient, because they have neither stature, nor a supply of food, to render them useful. In many places, they are reared for the market, and sent in droves to the South. In this case, it may be proper and profitable to keep a considerable number. But, in general, 6, 8, or 10, are kept on the smaller farms, for the purposes of agriculture alone."

The number of idle men servants, kept in the Highlands and

Hebrides, is also a dead weight on every farmer. This is the natural consequence of employing too many horses. Dr Walker observes, "That more than double the number of horses and men servants are employed in the north of Scotland, on a farm of the same description and extent, than in the south. In the former, a tenant who pays only *5l.* Sterling of yearly rent may be found with six labouring horses. On a farm of *20l.* may be found twelve or fourteen men and women servants. In short, there are few farms in the North Highlands but might be managed, and equally well cultivated, with one-third of the number of servants. In some cases, one-half of horses and men might serve the purpose." This, however, is partly occasioned by the climate. The long continued frosts, or storm, gives them but a short time to plough. It is the climate here that occasions this.

It is unnecessary to add, that such a number of horses and servants, utterly idle the greatest part of the year, must be a great obstacle to all improvement.

The number of cattle of every kind which are kept on these farms, is equally adverse to every improvement, either of the stock or soil. The proportion between the rent and stock of such farms, is a sufficient proof that they are overstocked. Dr Walker mentions a case in point. "A farm in Kintail was found to have on it 40 milch cows, which, with their young stock, from a calf to a four-year old, made about 120 head of cattle; besides 80 ewes and 40 goats, which, with their young, were about 250, and 10 horses. Yet this farm, though it contained arable land more than sufficient to supply all the family, besides this stock, was rented only at *twenty pounds* a year."

VI. *Distance from Manures, and neglect of such as they have at hand, is another great Obstacle to the Improvement of the Highlands and Hebrides.*

Of all manures, lime is one of the most efficacious and lasting. And wherever it abounds, and is properly used, improvement in the quality of the soil may be seen. Indeed, without this species of manure, the richest counties of Scotland must have remained in a comparatively unproductive state.

Yet this invaluable manure is almost inaccessible to the inhabitants of the Highlands and Western Isles; at least, the expense of the article, and of carriage to such a distance, either by sea or land, is so great, that few landlords, and still fewer tenants, can afford to give their lands a sufficient liming.

It is true, and it is fortunate for these districts, that limestone abounds in many parishes. But, want of coal to burn it, is a great obstacle to the improvement of land, by the use of this manure. Happily, in some parishes, peat has been used as a fuel for this purpose, with great success. And lime, burnt with peat, furnishes a far richer manure, than when coal is used as a fuel.

But the neglect of those manures, which are at hand, is another obstacle to improvement. Even the dung raised by their cattle is utterly neglected, and allowed to lye as a useless waste, over a great part of the Highlands and Hebrides. But, in place of being considered as of any value, it is regarded as a nuisance; and, in some cases, it is actually thrown into the nearest brook, in time of a flood, that it may be washed away.

Hitherto we have considered the Highlands and Hebrides chiefly as a pastoral district. But, in many parishes in both, corn is raised. Considering these parts as capable of greater cultivation, there are many obstacles to improvement peculiar to these districts.

VII. *Want of Proper Implements of Husbandry is a great bar to Improvement.*

Over a great part of the Highlands and Hebrides, the implements of husbandry are very defective. In some places they are as simple and inefficient, as those which were used in the remotest ages, when husbandry was first introduced into these regions.

The *Highland plough* is a very simple and feeble instrument; its whole length is about 4 feet 7 inches. Like that of the ancients, it has only one stilt or handle; the mouldboard is fixed to it by two leather straps; the coulter and sock are bound together at the point with a ring of iron. Four horses are yoked to this instrument, abreast, by thongs of leather. The driver, with the reins fixed to a cross-stick, walks backward before the horses; and to drive them forward, he strikes them on the face. The ploughman walks alongside of the plough, directing it with one hand by the stilt, and another man follows with a spade, to lay down the turf that is torn up.

The *Reestle* is another rude instrument used in the Hebrides. It is rendered necessary on account of the imperfection of their plough. It is similar in shape to that instrument, with a beam and one stilt. It has no *sock*, but only a single iron coulter, of the size and shape of a reaping-hook, but stronger; and it is drawn by one horse, driven by one man, while another directs it by the stilt. The object of this operation, is merely to open a passage for the plough, which follows after, by cutting the twisted roots of the weeds, with which the land is infested. Without this previous operation, their feeble plough would be obstructed.

The *Harrows* used in the Highlands are, if possible, still more imperfect than their plough. Some are like hay-rakes, and are managed by the hand; others are drawn by horses, but all have wooden teeth or tines. Of course they are so light and feeble, that they scarcely cover the seed, even in a soil which is free and frequently ploughed. But they have no effect in breaking and pulverizing the soil in such lands as have lain in lea for any time, especially as they are ploughed so imperfectly.

Their carts and cars are equally imperfect, as the implements named above. For the most part, carts, or wheel carriages of any kind, are unknown. All their corn and crop of every kind, and all their manure and materials for building, are transported from place to place on horseback, or on sledges.

It is true that, in general, the roads are so bad, that no wheel carriage could be used; but this is not the case universally. On the contrary, in many parts of the Highlands and Western Isles, excellent level roads are naturally formed. Especially in the flat levels and Islands, such as South-Uist, North-Uist, and Benbecula; yet few or no carts have ever been used. This is a great obstacle to the improvement of these districts. More horses, and men, and labour must be employed, than would otherwise be necessary. And more expense must be thrown away in conveying their crops and manure and other materials, such as kelp, from place to place yearly, than would purchase wheel carriages for these purposes.

VIII. *The Rotation of Crops raised in the Highlands and Hebrides, and the neglect of Green Crops in general, is a great obstacle to Improvement.*

The rotation pursued over the greatest part of these districts, is perhaps the most ruinous that could be devised. On their infield land, in general, they raise continual crops of grain without any respite. Alternate crops of bear and oats, without intermission, are cultivated on the same field. Sometimes two crops of the former, and four of the latter, in succession, form the produce of infield land.

Four, or even five crops of oats, are raised on the outfield land, and then it is allowed to rest for three years. After this, the same rotation is resumed.

IX. *Natural Obstacles to the Improvement of these Districts.*

Some of these are insurmountable. Others may be obviated, though not entirely removed. The insulated situation—the boisterous climate—the rough and rugged surface—the dangerous ferries—the distance from markets—and the inaccessible nature of these districts, are of the first description; for they may all be considered as obstacles to improvement, almost, or altogether insurmountable.

There are others which may be obviated in part, though not entirely removed. The want of regular posts and packet boats —the scarcity of wood—the want of artizans of every description—the irruptions of the sea, and overflowings of rivers—the want of shelter of every description for cattle and cover—and the desolations occasioned by sand-drift, are all natural and powerful obstacles to the improvement of these districts, which never can be wholly removed; yet they may all be partially obviated.

Such are the leading obstacles to improvement which are local, and almost peculiar to the Highlands and Hebrides. It now remains to point out

The Means of Removing these Obstacles.

Some of them, it is true, can hardly be surmounted; but if the landlord, the tenant and the Legislature, were to combine their united efforts, several of them might be altogether removed, and most of them may be partly remedied. It is indeed in the power of the landlord alone, to remove some of them; others may be remedied by the tenant; but it would require the additional aid and interference of the Legislature to obviate or remove entirely some of them, or even to alleviate others.

I. The landlord has it in his power to remove many of the obstacles above mentioned.

1. *Subletting of Land* he has it in his power to prevent. And this practice ought in every case to be abolished; excepting, perhaps, in those districts where the proprietors do not reside. In each of these, one or more tenants of superior rank and talents, should be placed to act as a Justice of the Peace, and a sensible farmer should act as a factor, in absence of the landlord. Of course he may possess a large farm. But if he be allowed to subset any part of it, a lease ought to be granted for a limited time to every possessor. In general, all persons, except the labourers attached to farms, ought to hold their lands immediately from the proprietor.

2. *Leases* ought to be granted to every tenant, great or small, in order to encourage him to improve his possession. Perhaps in no case ought these leases to be less than 15 or 20 years; and expressed in language so plain, that every tenant may fully understand them. The proprietor ought also to specify the improvements that ought to be attempted, as well as encourage those by an addition to his lease, or proportioned to the exertions he has made, and the expense he has incurred.

3. All *run-rig*, *township*, or *joint possessions* of every kind, ought immediately, and for ever, to be abolished; and the boundaries of every farm should be defined; and the arable part ought, as far as is possible, to be enclosed. If the tenant be employed

for this purpose, he ought to be paid by the landlord as any other labourer; and, on his part, he ought to pay 5 per cent. for the money thus expended.

4. *Letting of Land* in *Steel-bow*, or *Half-foot* possession, ought to be strictly prohibited by the landlord. And every lease to a tacksman ought to contain an article to this effect, under the penalty of forfeiture.

5. *All rent* ought to be paid in *money*; and all the services, servitudes, and casualties, to which the tenant was bound formerly, except as much victual as is really wanted for the landholder's family, ought to be converted into, and paid in cash. The only service that may in some cases be excepted is fuel.

6. The tenant ought not only to be better accommodated with a house, but sheds ought to be built, and a large cow-house and barn, suited to the farm, ought to be provided for him. The wood, stones, and lime and workmanship, ought to be furnished by the proprietor. The tenant ought to pay 5 per cent. for the money expended during his lease. Perhaps he ought to bear the sole burden of collecting rushes, reeds, fern, or heath, for thatch. But, if slates are used, the landlord ought to furnish and put them on, and charge interest as upon the other articles.

7. Every landlord ought to purchase one complete set of the most improved implements of husbandry, and use them himself, that his tenants may see the advantages of doing so. And he ought to procure, and sell at prime cost, similar implements to all his tenants who incline to use them. Even though he were to give a set annually as a premium to the most industrious of them, he would find it turn to his own account. But as these implements must need occasional repairs, he ought to invite and encourage mechanics of every description to settle on his property, or send young men at his own expense to be taught these arts. By returning to their native homes, they, in their turn, might teach others. Wood and iron, and every material awanting for these purposes, ought to be provided at first by the landlord, and sold at prime cost. Blacksmiths, and plough and cart wrights, ought to be established in every parish, in proportion to its extent.

8. The landlord should also set the example himself of using, or at least point out the method of using, all those natural manures which may be found on his estate. With this view he ought to be at some pains and expense to discover them, and allow the tenants the free use of them, till they have fully ascertained their value.

9. Every landlord, if possible, ought to have a farm in his own possession. His example would go far beyond any precept. Indeed, without such a stimulus, few experiments will be made, and as few improvements introduced.

Much has already been done in this way by the liberal and enlightened landlords of the Highlands and Hebrides. Isla, Gigha, Collonsay, and Coll, and many parts of Mull, Ulva, and Skye, bear testimony to this. And the successors and tenants of Mr Campbell of Shawfield, Mr M'Neil of Collonsay, and Mr M'Neil of Gigha, and of many other proprietors, will long feel the benefit of their exertions, after they are laid in the dust. In many of the remotest districts of the Highlands, similar examples have been exhibited with similar success; yet much remains to be done before these districts can be improved.

II. But much may also be done by the tenants themselves, and many obstacles to improvement may be removed by their exertions, especially when combined with those of their landlords.

1. The lateness of their harvests is one of the greatest evils complained of in the Highlands and Hebrides. Indeed this evil is more felt there than in any other district in Scotland; for, about the time of the autumnal equinox, more violent winds prevail, and more rains fall, than in the Lowlands.

Yet this evil may be partly removed by the *tenant*; as it is owing in a great measure to his late sowing. A preposterous rule is generally followed by most tenants in these districts, never to begin to plough till Old Candlemas, nor to sow till after the 20th March. In some places no grain is sown till after the beginning of April. Even oats and rye are delayed till the end of that month, and sometimes to the middle of May. And bear is seldom sown till the end of that month; yet, when the season is favourable it is sometimes reaped in August. This is a proof that the late harvest is not owing to the soil. It is partly to be ascribed to the climate, and partly to the tenants delaying to plough and sow sooner, or not procuring the earliest kinds of seed.

That it is in their power, and that it would be their interest, to perform both these operations four, five, or even six weeks sooner, Dr Walker asserts. He says that their arable lands are in many places low and nearly on a level with the sea: that their soil is every where of a sharp and forward nature: that, though drenched with rain, a few dry days in February and March prepare it for the harrow.

He points out the obvious advantages that must be the consequence of sowing a month earlier than is commonly done, that the harvest would be early in proportion, and the grain more plump; and to prove this, he states that, in the year 1787, a field of common barley, after being sadly demolished by the weather, was only reaped on the 16th November: but that it was not sown till the 26th of May. And he adds, that in the immediate neighbourhood, another and a better farmer had a hearty crop of Lincolnshire barley (a much later grain) in his barn-yard on the

25th of October. All this advantage was owing to his having sown it on the 8th of March.

In short, there appears to be no doubt, that over the Highlands and Hebrides, harvest may become a month earlier than it generally is, by early labour, early kind of corn, and early sowing.

2. The quality of the grain raised in the Highlands and Hebrides, might be greatly improved by the exertions of the tenantry. By the same means, the quantity might also be greatly increased.

All agree, that the grain raised in these districts, is greatly inferior in quality to that of any other in Scotland. The average quantity of meal which oats yield per boll, may be stated as follows. In general, from 10 to 16 pecks per boll over the rest of Scotland; and in the best cultivated counties, from 12 to 18. Whereas the same quantity of oats, in the Highlands and Hebrides, owing to the bad kind of seed used, viz. the grey oats, on an average, yields only from 4 to 6 pecks of meal.

The *quantity of grain* produced per acre, is still more deficient. Much of the arable land, says Dr Walker, in the northern parts of Argyleshire, the western parts of Inverness and Ross-shire, and in most of the Islands, when sown with grey oats, (by far the most commonly sown of any grain), affords only an increase of three to one. The usual produce of rye, is four seeds: And that of bear is under five, and seldom exceeds eight seeds. There are fertile islands, such as Isla, South Uist, and others, which are more productive, yielding ten to fifteen, and even twenty or twenty-five seeds, of this grain. But this remarkable increase is only in those spots which are cultivated with the spade, plentifully supplied with sea-ware as a manure, and sown very thin.

This great inferiority in the quality and quantity of grain, however, is not owing to the sterility of the soil, or inhospitable nature of the climate of these districts. It is chiefly to be ascribed to the inattention of the tenants, to the kind of grain which they cultivate—to the quality of the seed they sow—and to the rotation of crops which they raise.

1. The kind of grain, especially of oats, which is generally cultivated, is the very worst and least productive. Over the greatest part of the Highlands and Hebrides, Grey oats alone are cultivated; whereas if early Blainslie, or Black, or, still more, if Tartarian oats were introduced, the increase might be doubled, and the quality of the grain increased in the same proportion. In some of the low-lying, warm, and sheltered spots, Friesland oats would be still more productive. Perhaps, however, the Tartarian oat is most generally adapted to these districts. It grows luxuriantly even in a stormy climate. It yields a great increase both of corn and straw. As the ear or panicle hangs all

to one side, it is of course turned from the wind, and on this account it is not liable to be shaken.

The proprietors should be the first to introduce and cultivate these kinds of grain, and to purchase and sell them to their tenants for seed, at prime cost; or even give them *gratis*, in small quantities, as premiums to those most deserving of encouragement.

2. Little attention is paid to the quality of the seed sown: Or rather, in many cases, the weakest and worst of their oats and bear is selected for this purpose. It is true, that weak grain, which will yield but a small proportion of meal, will spring. But it is equally true, that the plants produced by it must be weak in proportion. Nothing, therefore, can be more preposterous than the practice of sowing weak grain. A penny may be thereby saved in spring, but a pound is lost in harvest.

Hence, in every country where cultivation is carried on with judgment, the utmost care is taken to procure the very best and plumpest grain for seed. There, too, they are at much pains to change their seed from year to year, or as often as they find it necessary. Yet this precaution is for the most part totally overlooked in the Highlands and Hebrides. When the same grain is cultivated on the same soil, without intermission, however rich that soil may be originally, that grain uniformly degenerates. For this cause, a change of seed is absolutely requisite; and the neglect of this is one cause of the inferiority of the grain of the Highlands and Hebrides, both in quality and quantity.

Dr Walker specifies an instance in point. Mr Campbell of Dunstaffnage imported bear from Glasgow, which he sowed on his farm of Icolmkill. Besides a much larger crop, the grain which it produced was of superior quality. He sold it at one-third dearer than any other bear in the island.

But the inferiority of the grain produced in the Highlands and Hebrides, may be ascribed to,

3. The rotation of crops raised in these districts. It is in the power of the tenant to alter this rotation, and by this means improve both the quality and quantity of his crop. In place of a perpetual succession of grain, or white crops, which is the prevalent rotation, a green crop ought to be introduced between each. An alternate succession of white and green crops would improve the whole arable land, and more than double the produce of it. But such a rotation is impracticable, in most parts of the Highlands and Hebrides. A more imperfect rotation, however, is practicable, and would be a great improvement. In every case where bear is sown, grass-seeds should be introduced. This would furnish one crop of hay; and corn might be cultivated, after this, with success.

Green crops of many kinds might be thrown in, over a great part of these districts, to great advantage: especially in low-lying situations, where natural or artificial manures can be procured, and where the arable land is enclosed. The ingenious authors of the Reprinted Reports of the Hebrides, and of all the counties of the Highlands, uniformly complain of the want of green crops, and with all their eloquence recommend the extensive cultivation of them, as one of the most effectual means of reclaiming waste land, enriching the soil already cultivated, and increasing the produce of it, both for the use of man and beast.

Waste lands can by no other process be more easily or effectually reclaimed, than by a complete fallow or a green crop. Potatoes, of course, are raised in lazy-beds, over a great part of the Highlands and Hebrides. Indeed, for half a century past, there has been little if any additions made to the cultivated land, but by this practice. It ought therefore to be extended more and more, especially if this species of crop be confined to waste land.

By this means, the quantity of land fit for cultivation, and capable of bearing crops of grass or grain may be gradually increased. As a proof of this, Dr Walker mentions that potatoes were first introduced into South Uist about the year 1743; that, in the course of twenty-one years, upwards of nine hundred acres were thus reclaimed and rendered capable of cultivation by the plough or spade. And in the Isle of Skye, he adds, that twenty acres were added to every farm of 20*l.* of yearly rent, by planting potatoes on land never formerly cultivated. Nay, on one single farm in the district of Arisaig, there were raised no less than 400 bolls of potatoes, in one year, and all on land which had never before been in any culture whatever. As a further proof of the immense advantage of such a crop, he mentions another farm in the same county, which, in the year 1749, only raised from 12 to 15 bolls of grain, and reared only 40 cows, whereas, in 1764, 37 bolls of grain were raised, and no less than 70 cattle, of larger size and better fed, were maintained. Yet this vast increase of produce, in the short period of 15 years, was entirely owing to the bringing in of waste and wild land by potatoes.

Arable lands may be cleaned and improved by a crop of turnips. Were a poor farmer told, that, by raising this plant, he might have milk for himself and his family all the year round—that he might double his winter provision for his cattle, and the quantity of dung for his farm—that much more corn might be raised, and reserved for meal to his family—and that the weakest, and worst of his land would be cleaned and enriched, by throwing in turnips into his rotation, he would doubtless be amazed, and apt to conclude, that this was an idle tale. But the landlord, by cultivating this crop himself, and by encouraging his tenants to follow his example, would soon open their eyes, and carry conviction to their minds, of the practicability of such a plan, and the vast value of it.

It was by a similar plan, that potatoes were first introduced into the Hebrides. The inhabitants were as ignorant of the use of this plant, and as much averse to the cultivation of it, as they now are of the value of turnip. But the Laird of Clanronald, in the year 1743, first introduced potatoes from Ireland. With all the solicitude of a parent, he assembled his tenants together, as soon as he arrived with his cargo. He pointed out and explained to them the mode of cultivating such a crop. But, with one consent, they refused to accept of, or to plant this valuable root. By an exertion of that authority, which the chief of a clan could exercise, he compelled them to make the attempt. But after the crop was raised in autumn, some of the tenants brought it to their landlord's gate, saying, that he might indeed compel them to plant such foolish roots, but they should not be forced to *eat* them. In a short time, however, they saw their error; and the potatoe was found to be, and is still called, the *Poor man's boll*, as a proof of the high estimation in which it is held.

It is by similar exertions, and such an example, that turnips and other green crops can be introduced or cultivated with success in the Highlands and Hebrides.

By cultivating it, much sandy land might be reclaimed—most of their infield land would be cleaned and enriched—green food might be provided in winter for their stock—the breed, both of black cattle and sheep, might be greatly improved in size and value—more dung would be raised—more cattle reared—and the land would become more productive of grain—while many thousands of cattle might be saved from disease and want, and absolute starvation in winter.

There are many other species of green crops, of equal value, and some even better adapted for the soil and climate of the Hebrides and Highlands, than common turnip. The Swedish turnip, (ruta baga), is in particular to be recommended, as one of the hardiest roots that is known. It subsists during the severity of winter, and serves as green food, after the turnip decays in spring. Even after it springs afresh, its root remains firm and fit for use, which is not the case with turnip. Of course, both the young shoots, and the old root, serve as food during the critical months of April and May, when winter fodder is generally gone, and when the grass in the fields has scarcely sprung.

In short, if the tenant were properly instructed, and encouraged by his landlord, to extend the culture of every species of green crop, and introduce them in a proper course of rotation, the soil of the Hebrides and Highlands would by this means be rendered far more prolific of food for man and beast.

But cattle, not corn, are the staple commodity, and the chief production of these districts. To improve the breed, and increase the stock of cattle, is also in the power of the tenant, especially if aided by the exertions of the landlord. The former, by taking care never to overstock his farm; and the latter, by introducing new, or improving the old stock of cattle, might, by their united exertions, accomplish this great end.

On this subject, many judicious hints are suggested in the reprinted Report of the Hebrides. The following are quoted as highly deserving of the attention, both of the tenants, and landed proprietors, of these islands.

"1. Both landlord and tenants should consult competent judges, in order to fix on the sorts, numbers, and proportions of live stock which they ought to allot to their farms. The pernicious, but too common practice of overstocking the land, ought to be carefully avoided; and every encouragement for improving the breed and management of his stock, should be afforded to the tenant.

"2. The size of cattle and horses ought not to be forced all at once beyond the abilities of the smaller tenants, and the powers of the pasture to maintain them. Proprietors, and gentlemen farmers, ought to commence the introduction of enlarged and improved breeds. They should gradually rear flocks of Cheviot and Spanish sheep on their pastures, before they recommend them to their tenants and dependants.

"3. The farmer should discriminate between the pastures adapted to different sorts of live stock, at the various seasons of the year; and act accordingly. It is preposterous to keep cows, horses, and sheep, on the same pastures, in every sort of weather, all the year round. Yet this is often done in many of the Western Isles.

"4. Attention ought to be paid to the difference between pastures fit for breeding, and those adapted to fattening of cattle. Each of these should be carefully applied to its appropriate use, and not pastured promiscuously.

"5. The best breeds of black cattle which the Highlands and Hebrides produce, should be carefully reared and propagated, without mixture and adulteration, by any foreign breeds.

"6. In rearing calves, hay tea should be generally used; and care should be taken not to stint the young cattle of provender; but, on the contrary, as much green food and hay ought to be provided as possible, while they are young, and in a growing state.

"7. The *Gearran*, or true Highland and Hebridian breed of horses, should be retained. But every effort should be made to improve that breed. With this view, stallions of the greatest size, and most beautiful form, and mares of the finest figure, ought to be selected for this purpose. By this means, the native horses of the Hebrides might be reared and improved to such a pitch, that they might be fit for the plough, the cart, or the saddle; and, by being thus improved, one third of the number might be sufficient for all these purposes.

"8. On the Mainland, or Highlands, perhaps a larger breed of horses ought to be introduced. Stallions, therefore, ought to be procured by the proprietors from the South, and allowed to cover gratis, or at an easy rate, over all their property. Many landlords of the Hebrides have already shown such a patriotic spirit; and perhaps none more than Mr Campbell of Shawfield. The Island of Isla will, of course, soon abound wlth horses of a different, though not inferior breed, to any in Scotland.

"9. The utmost care ought to be taken to improve the quality, and extend the quantity of meadows fit for hay. Flooding them in spring might accomplish the one, and draining morasses might serve the other purpose. Many meadows might be flooded at a very trifling expense, by which the crop might be greatly increased in quantity as well as quality; and many morasses and mosses might, at a small sum, be converted into meadow lands, by first draining, and then flooding them."

But more ample and accurate information on this subject may be found in Dr Walker's posthumous work, so often quoted. To that the reader is referred.

While so much may be accomplished by the united exertions of the landlord and tenant,

III. *The Legislature ought also to co-operate.*

Indeed, without this powerful aid, many of the greatest obstacles to the improvement of these districts never will be completely obviated.

Of all the obstacles to the improvement of pastoral districts, such as the Highlands and Hebrides,

1. *The Duty on Salt* is one of the greatest. Yet neither the landlord, nor tenant, nor both united, can remove it. The Legislature alone can give relief from such a burden.

There can be no doubt, that this duty operates as a powerful obstacle to the agricultural interests of Britain at large. For, if it were removed, salt might be used as a powerful manure, especially in those districts at a distance from lime. It might be used with advantage, mixed with the food of cattle; and it would operate as a powerful preventive, too, of many of those diseases so fatal to live stock.

But while the operation of this duty is felt, over the whole kingdom, as a bar to improvement, it is still more severely felt, and sometimes absolutely ruinous, to the remote regions of the Highlands and Hebrides. Cattle, and not corn, are the natural produce of these districts. For this produce they have no market at hand. In most cases, they must be driven a hundred, or sometimes two hundred miles. And what adds tenfold to this calamity is, that this market often fails; so that the tenant is under the dire necessity of driving his cattle home again, and to return pennyless, with his stock greatly reduced in value. Nay, to consummate his ruin, he has nothing to pay his rent, nor any provender to support this superabundant stock through the winter.

Whereas, if the duty on salt were removed, all these ruinous consequences might have been prevented. For, in such a stagnation of the market, the grazier might cause his cattle to be killed, in place of being carried home to starve; and, when salted and barrelled up for the market, they might either be preserved, or sold off for ready cash.

Besides, as many cattle, even in these Northern districts, are found in good order for the butcher, in place of selling these off to the graziers of the South, they might be killed and salted near the spot where they were fed, and barrelled up for the market. The saving to the feeder, in such cases, including the offal, which might be useful to his family, may be safely stated at much more than 20 per cent.

2. The landholders ought to establish villages, and the Legislature should encourage the inhabitants of the Highlands and Hebrides to settle in them. There are many advantages that accrue to the public from such establishments; and they are in many respects preferable to large and populous cities. The health of the inhabitants of any country is better secured, when they are scattered over the face of it in villages, than when cooped up in large cities—an amicable intercourse is kept up between husbandmen and manufacturers, by a mutual interchange of kind offices—the operative class of the community, too, are in less danger of entering into cabals and combinations—living is generally cheaper, and house rents much lower in villages than in cities—above all, the interests of agriculture, and the improvement of the country, may be thus more generally promoted—and emigration may, in a great measure, be prevented from the Highlands and Hebrides, especially if employment were found for the inhabitants.

As a proof that this great end may be accomplished, many of the manufacturers in Glasgow and Paisley have employed weavers at the distance of thirty, forty, and fifty miles; and, not many years ago, a considerable part of the linen manufacture of Edinburgh was executed by weavers in the county of Inverness. If villages were established over a great part of the Highlands, and especially along the sea-shores and banks of the Caledonian and Crinan canals; and if small branches of our manufactures were thus spread over the country, in place of being altogether limited to one or two populous cities or counties, all the above advantages might be attained; and it becomes the Legislature to give every possible encouragement to such a plan.

3. *Fisheries*, if also encouraged, would furnish employment to the inhabitants of such villages, and would promote agriculture in their neighbourhood. To point out the precise situations for such establishments, is not necessary here to dwell on. Suffice

it to say, that the mouths of all the rivers, the banks of the lakes, and the creeks along the sea-shores of the Highlands and Hebrides, are peculiarly adapted for this purpose. Oban, Tobermory, Fort-William, Arisaig, &c. have been pointed out by some of the agricultural Reports. And in Knox's Tour, and Dr Walker's History of the Hebrides, and the Essays of Dr Rennie, Kilsyth, and General Dirom of Mount-Annan, many excellent hints may be found on this subject.

It is true, that the inhabitants of these districts are generally unable to purchase the apparatus requisite for Fisheries. The landholders, too, may be unwilling to aid them, or embark in such a business. On these accounts, the Legislature ought to interfere. If a few boats, and nets, and barrels, and a sufficient quantity of salt, were furnished at the expense of Government, the interest might be paid in fish annually by the settlers; and, if successful, they might be enabled ultimately to refund the capital; if not, the sum would be sunk to good purpose; and experiments might be made, and fisheries established, sufficient to indemnify the public for such an outlay. If but one new fishing station were discovered, and one village to succeed where none existed before, this would be an ample remuneration.

It may be said that these new settlers would be utterly ignorant of the secrets of the art of fishing, especially in the deep sea, and still more ignorant of the best mode of curing fish, when caught. But the cure of this evil is obvious and easy. Government ought to call in the aid of the most skilful fishers along the coast of Holland. By every encouragement in their power, they ought to invite these men to settle on the coast of Scotland, and the British shores. By this means, that most useful and essential branch might be transferred from the Continent to our coasts. If but ten men of capital and skill in that branch were to be settled in different stations along our coasts, they might commence and carry on a national undertaking, which would enrich themselves, and add to the national resources of Britain; one which might ultimately be of incalculable benefit.

4. *Packet-Boats* ought to be established by Government. These ought to ply weekly, or more frequently, as need required, between the different stations along the coasts of Scotland, and the great market towns, and likewise between them and the chief islands of the Hebrides; especially where villages and fisheries were established and encouraged. The want of these is felt as a grievous evil, and great obstacle to improvement, in every branch of political economy. And that want cannot be supplied by the landlords, far less by the inhabitants of these districts. Yet there is no doubt that if Government were once to establish such communications, all the inhabitants of all ranks would rejoice to encourage, and even contribute, liberally, to keep them up.

5. *Schools* ought to be encouraged by the authority of Government, wherever such establishments are formed. Such institutions, indeed, ought neither to be formed nor supported solely by Government. Every landlord, every tenant, and every society or class of the community ought to concur in such a measure. And there can be no doubt of such concurrence, if a plan were once digested for this purpose. It is truly gratifying to every feeling heart, to hear that a plan is already in agitation, of establishing itinerary teachers over the Highlands and Hebrides. Such a plan claims the protection and powerful aid of the Highland and Bible Society, and even of the Legislature itself.

6. *Sand drift* is an evil peculiar to the Highlands and Hebrides. And when we see the National Institute of France making such vast exertions to remove such a fatal and destructive calamity, surely it becomes the Government of Britain to exert itself in such a cause.

The *Pinus maritimus* was discovered by two of the Members of the National Institute. It is the only tree that flourishes on moving sands; and the coasts of Bourdeaux, formerly sterile in themselves, and destructive to the neighbourhood, by sand-drift, are already partly covered with this plant.

Many of the *Gramina* may serve a similar purpose. Sea-bent, sea lime-grass, sea canary-grass, spear-leaved ovache, spurry, sea bugles, sea bird-weed, salt-wort, sea knot-grass, Galloway fescue, and many others, might be cultivated on blowing sands, to cover the surface with a green sod, and prevent its drifting. And Government ought to encourage every experiment for this purpose. The proprietors and tenants would in this case follow the example, wherever they saw it crowned with success.

CONCLUSION.

APPENDIX, No. 1.

POLITICAL MAXIMS, REGARDING THE IMPORTANCE OF AGRICULTURE, AND THE MEANS OF PROMOTING ITS IMPROVEMENT.

By SIR JOHN SINCLAIR.

1. No nation will prosper long, unless it can be provided with food;—*in sufficient abundance*, exporting any unnecessary surplus; —*at reasonable rates*, but so as fully to repay the expenses of cultivation;—and, where the extent of its territory will admit of it, *by domestic industry*.

2. Where provisions are scarce and dear, and the taxes, whether direct, or indirect, are high, the pressure must be doubly felt by the great body of the people; nor can they afford to pay, without severe retrenchments, what otherwise they might furnish, without difficulty, to the public treasury. If cheapness, however, is the result of the importation of foreign corn, and not of domestic industry, the treasures of the country are exhausted in the promotion of foreign agriculture; and the cultivation of the soil at home, the proper basis of national prosperity, is fatally and inevitably discouraged.

3. The more the population of a country increases, it is the more necessary for its government to consider, what means are the most likely to be effectual; 1. To augment the produce of the land already in cultivation, by the establishment of improved systems of husbandry; and, 2. To encourage the cultivation and improvement of any barren soil.

4. Neither the old cultivated land, however, can be rendered more productive than formerly, nor can new soil be brought into cultivation, unless the Legislature removes every obstacle to improvement, and encourages, by every means in its power, agricultural industry; nor unless the farmers are possessed of skill, capital, and spirit, to carry on their operations.

5. In no department, is Bacon's celebrated maxim more true, (*Knowledge is Power*), than in regard to agriculture: Hence no farmer can be accounted skilful in his profession, who does not

avail himself of the information to be derived from the experience of others, and who does not improve his knowledge of husbandry, by the perusal of the ablest works which have been published on that subject. It is absurd to imagine, that the communication of knowledge by printing, which has promoted the advancement of every other art, should be of no use in agriculture.

6. Capital will soon be acquired by farmers possessed of prudence, skill, and industry, where credit is attainable, where a circulating medium abounds, and where the occupier of the soil is protected, except in times of scarcity, from the destructive intrusion of foreign competitors.

7. But skill and capital are acquired in vain, unless a farmer likewise possesses energy to carry on his agricultural operations. That, however, must depend, on the countenance given by the Legislature to the cultivation of the soil; on the establishment of public institutions to promote a diffusion of knowledge, and a spirit of agricultural improvement; and, above all, on the encouragement given by the landlord to his tenants, *by means of leases*, without which the agricultural, can never be accounted a liberal profession, and will never be followed by persons possessed of an independent spirit, of capital, or of ability. Certainty in his tenure, can alone furnish a sufficient stimulus to the farmer, to make the necessary exertions for the improvement of his land.

8. Where agriculture is considered, by the Government of a country, as the proper basis of public prosperity, and as such is duly encouraged, a nation, possessed of an adequate extent of territory, must become great and independent; but where, to prosperous agriculture, extended commerce and numerous manufactures are conjoined, an empire is raised to the highest pitch of power and opulence; and when wisely governed, it is more likely than any other, both to acquire political strength, and to establish, on sure foundations, "THE PERMANENT HAPPINESS "OF A GREAT COMMUNITY."

POSTSCRIPT.

The principal source of all the financial difficulties of this country, is, the enormous importation of foreign corn, and the immense sums we have paid for obtaining that supply. The total amount, for the last twenty years, will appear from the following authentic document.

An Account of the Real Value of Corn, Grain, Meal and Flour, imported into Great Britain from Foreign Parts, in each year, from 1792 *to* 1811, *both inclusive.*

YEARS.	Real Value of Foreign Corn, &c. Imported.
1792 - - - -	L. 856,095
1793 - - - -	2,021,993
1794 - - - -	1,768,811
1795 - - - -	1,461,622
1796 - - - -	4,487,116
1797 - - - -	1,455,722
1798 - - - -	1,569,757
1799 - - - -	1,765,840
1800 - - - -	8,755,995
1801 - - - -	10,149,098
1802 - - - -	2,155,794
1803 - - - -	1,164,592
1804 - - - -	1,855,333
1805 - - - -	3,754,831
1806 - - - -	1,106,540
1807 - - - -	1,878,521
1808 - - - -	336,460
1809 - - - -	2,705,496
1810 - - - -	7,077,865
1811 - - - -	1,092,804
Total 20 years,	L. 57,420,285

Above one-half of this amount was probably paid for in specie, a large proportion of which, it is said, found its way to France, and enabled it to carry on the war, which otherwise it might have been under the necessity of abandoning. These are circumstances the more to be lamented, because there never could have been any occasion, to have sent any considerable part of that immense treasure to foreign, and to hostile nations, had adequate encouragement been given to agricultural exertion, within our own territory. Indeed, had a *General Bill of Enclosure* passed when it was originally proposed, it would have saved by far the largest proportion of the fifty-seven millions we have paid, during the last twenty years, for foreign grain, which has been productive of such injurious consequences to the prosperity of this country.

September 1812.

CONCLUSION. APP. No. 2.

PLAN OF A SOCIETY FOR PROMOTING AGRICULTURAL IMPROVEMENT. TO BE CONSTITUTND BY A ROYAL OR PARLIAMENTARY CHARTER.

By SIR JOHN SINCLAIR.

Introduction.

THE improvement of a country depends upon three particulars:—1. Skill; 2. Spirit; and, 3. Capital.

In regard to *skill*, there never existed, in any country, so great an accumulation of agricultural knowledge, as what Great Britain now possesses; and it is rapidly disseminating over the whole kingdom, both by the publications of the Board of Agriculture, and the works of many intelligent authors, who are repeatedly discussing that subject.

That *a spirit of improvement* exists, is evident, by the demand for books on husbandry; by the number of private agricultural societies which have been recently established; by the pleasure with which agricultural subjects are so generally discussed; and by the extensive improvements which are now carrying on in every quarter of the kingdom. Unfortunately, however, these improvements have not kept pace with the increasing demand for food; and hence it has been found necessary to pay to foreigners, in the short space of twenty years, *above fifty-seven millions Sterling*, for articles which, by proper exertions, might easily have been raised at home, had our cultivation been carried to that height of which it is capable.

As there is land enough in the country, either now lying waste, or imperfectly cultivated, to raise all the articles we want, and no deficiency either in skill or spirit, *the want of capital* is the only circumstance that can have prevented improvements from being carried on, to any extent that our necessities could require. Landed gentlemen, indeed, have very rarely much money to spare; find it often difficult to borrow on the securities they can offer; and are naturally apprehensive, when money becomes scarce, of being called upon for repayment: whereas, if they could be supplied with money at a moderate rate of interest, or if the burden varied according to the profit made from the undertaking, and if the principal were in no case to be demanded, there are no limits to the improvements which might be carried on, but the boundaries of the Island.

In order to effect so important an object, the following plan is suggested.

PLAN OF THE SOCIETY.

That under the authority of Parliament, the sum of one million (or any other sum adequate to the purpose) be raised by a joint-stock company, in shares of 50*l.* each, or 20,000 shares in all, for the purpose of promoting the improvement of the country.

That the management of the concern be confided to a president, five vice-presidents, and twelve directors, as is usual in similar cases.

That where any improvement is to be carried on, the company shall be authorized, under such restrictions as may be thought advisable, to lend to the proprietors of landed estates a sum of money for improving the same.

That the proprietor shall pay, for such money, a certain interest of 4 per cent., and also one half of any profit to be derived from the improvement beyond 4 per cent.; and that the same shall be a real burden upon the property, in the nature of a rent charge.

That in the case of plantations, no annual interest shall be paid, but that, at the end of thirty years, such plantations shall be valued; and either one half of the value thereof shall be paid to the Society, or one half of the plantation shall be allotted to the same, to be either cut down, or preserved, as the company shall think most advisable.

I. *Profit to the Proprietors of Land.*

The terms above proposed for borrowing money, are abundantly favourable to the landed proprietor; because, 1. The rate of interest he is bound to pay, namely, 4 per cent., is certainly moderate. 2. The additional interest depends upon the success of the improvement; and the more he pays to the Society, the more he puts into his own pocket. 3. The principal can never be demanded; so that he need never entertain any apprehensions on that account. In some cases, both parties might be inclined, that the money borrowed shall bear, in perpetuity, an interest of 6 per cent., which, in this case, might be legalized by Parliament.

II. *Profit to the Society.*

It must be a great satisfaction to any company, to promote such improvements as are likely to take place, under the auspices of such an institution as the one now proposed, more especially when it will be accompanied with such profit as may be expected in the present instance. The payment of 4 per cent. is fixed on the most undoubted security; and, if the money is laid out to advantage, the additional income to be received must be very considerable. Where waste lands are improved on a proper system, the profit on the money expended ought to be at the rate of from 8 to 10 per cent.; in which case, the company would receive above 6 per cent. for the money advanced. Where the improvement is carried on by irrigation, or by draining, the profit is still greater, often from 15 to 20 per cent.; and in the case of plantations, the advantage would be very considerable, exceeding the value of the sum laid out, with compound interest at the rate of 6 per cent.

III. *Profit to the Public.*

There is no institution that could be better entitled to public support. By increasing the capital, as might be necessary, (which might easily be done in time of peace, when money is cheap and abundant), every acre in the kingdom would either become covered with wood, or loaded with agricultural productions; and all that floating capital, which might otherwise remain either unemployed at home, or might be sent to foreign countries from the difficulty of placing it out to advantage, would thus be laid out in promoting our domestic improvement, and rendering the whole kingdom one uninterrupted scene of industry and cultivation.

London, 10th April, 1806.

CONCLUSION. APP. No. 3.

HINTS REGARDING THE CORN LAWS.

By SIR JOHN SINCLAIR.

AFTER all that has been written on the subject of the Corn Laws, the real question at issue may be brought within a very moderate compass.

1. The first object must be, "*To procure an independent supply;*" for a nation ought not to trust to its enemies, or those who may become so, for the means of its subsistence. Much have we suffered by following a different system. Within the short period of twenty years, we have exported little short of sixty millions Sterling for grain; "exhausting, for articles that might have been raised at home, our metallic currency; stimulating the agriculture of hostile nations, and swelling their financial resources, for our destruction." Whereas if the lands, now in culture, had been rendered more productive, and the waste lands of the kingdom had been improved, a large proportion of that immense treasure might have been retained at home. But the fact is, that it is impossible to increase the produce of the lands already in cultivation, or to improve our wastes, *but at a great expense*. Hence arises the necessity of high prices. The produce of our fertile lands, which can be cultivated at a moderate expense, would not feed one half of our population. The more barren lands cannot be cultivated at the same rate. It would be perfectly unequitable, however, to permit the produce of *the barren lands* of this country, more especially in unfavourable seasons, to be put in competition with the produce of *the fertile fields* of other countries.

2. The next object is, "*To have grain at a steady price,*"

which, under the judicious regulations of a former system, was the case for almost a century. Nothing can be more ruinous, more especially to the middling and lower classes of the community, than great fluctuations in price. They are unable in that case to apportion their expenditure to their income. When grain is uncommonly cheap, manufacturers are apt to give up regular labour, and to devote a considerable portion of their time to idleness and extravagance, greatly to their own injury, and to the loss of their employers. On the other hand, when the prices rise, their misery is extreme. But when, by judicious regulations, *the price is steady*, it is their own fault if their situation is not uniformly comfortable.

3. The third object is, "*To give domestic a decided preference over foreign industry.*" The manufacturing and commercial interests violently contend for this principle, when it suits their own interest; but oppose it, with equal violence, when they think it is not for their advantage. For instance, they say, '*Prohibit the exportation of British wool; give a decided preference to British shipping; lay duties upon all foreign manufactures, as woollens, cottons, silks, linens, china, &c. Secure to us the monopoly of the home market for every article we can produce; but whilst we receive these advantages, let the importation of foreign corn be encouraged, without regarding the effect it may have on the industry of the British farmer.*' But is this just and equitable? If any peculiar encouragement should be given, either to the agricultural or manufacturing classes of the community, the preference ought assuredly to be given to the former, who are in a manner fixed to the soil, whereas the latter may abandon it whenever they think it for their advantage, and settle in other countries. Let no peculiar advantage, however, be given to either; only let the same principle, *of reciprocal preference*, be enforced in both cases.

4. The landed interest are also entitled to be indemnified, for the losses they have sustained, in supporting the manufacturing and commercial classes. The immense load of national debt, and the heavy taxes thence originating, have in a great degree proceeded from an anxiety to promote commerce, and to procure markets for our manufacturing industry. How many millions has it not cost the landed interest, to establish distant colonies, and to maintain fleets and armies for their defence, chiefly for the purposes of trade, and the consumption of our manufactures? But though the landed interest have suffered so essentially by these means, it is contended, that they are not to receive any indemnification for those losses. Their incomes are to remain stationary, *whilst they are to be loaded with all the expenses of commercial warfare.*

5. In a prosperous country, the value of money, as the medium of exchange, is perpetually diminishing. The price of labour, and of every article of consumption, rises accordingly;

but it is contended, at the same time, that the price of the productions of the soil ought to remain the same. Can any thing be more unreasonable? and is it not evident that, whilst other articles become dearer, the value of grain should increase in proportion?

On the whole, the landed and farming interests claim, in their own behalf, and that of the public at large, that the following principles be kept in view, in the arrangement with regard to the Corn Laws about to take place:—1. An independent supply. 2. Steady, instead of fluctuating prices. 3. A decided preference in favour of domestic, when compared to foreign industry. 4. Indemnification for supporting the manufacturing and commercial interests. And, 5. An increased rate on importation, adequate to the increased price of other articles. If these principles are now acted upon, the country will prosper. The manufacturing and commercial interests will have the best of all markets, *a market at home*, for their productions, and, in that respect, will be less dependent upon foreign countries. Nothing, indeed, can be more absurd, than to employ the capital of the country, in supplying foreign nations with manufactures, which can only be paid for, by the importation of foreign grain, to the injury of the British farmer; for, in order to render that grain admissible, the value of the whole agricultural produce of the country must be depreciated.

Unless justice, therefore, is done to the industry of the British farmer, it is but equitable, and ought to be insisted on, not only that wages, and the price of labour, should be reduced, but that full latitude be given, to export wool, grain, and every other production of the soil; and that every species of manufacture consumed at home, as woollens, cottons, silks, linens, iron, china, &c. should be admitted duty free. *Such monopolies are unfair, unless they are reciprocal.* Nothing but the enforcing of such a system, will convince the manufacturing and commercial interests, of the injustice and impolicy of the measures they are now pursuing. They would soon be satisfied, were that plan to take place, 'that 'all the classes of which a great nation consists, ought to support the others; and that regulations which may more immediately tend to the advantage of one, will ultimately promote the interests and prosperity of every class in the community.'

Above all, it is essential for those, whose business it is to import,—to manufacture,—or to retail commodities for the internal use and consumption of the country, not to countenance any measures likely to prove injurious to agriculture; for what would become of them, if the landed and farming interests, *their best customers*, were to be reduced to poverty and distress?

Edinburgh, April 1814.

MR NAISMITH has recently transmitted the following communication, being the

SEQUEL OF HIS EXPERIMENTAL INQUIRY INTO THE NATURE OF PEAT-MOSS.

(See No. 2. of Chapter XI. page 2. of this Volume.)

WHEN the few experiments of 1812, already recorded, were ended, the four flower-pots were deposited in a lumber garret till the return of spring.

On the *16th of February* 1813, after the contents of all the four were sufficiently moistened, three sound grains of wheat were planted on each, and they were placed in the inside of a window, in a room where a fire was kept, and regularly watered. On the 6th of March a plant appeared on No. 3.; and on the 8th there were two on it, and one on each of the other three.

When walking along the lower side of the peat-moss first described in the former part of this Inquiry, some fragments were observed which had been lifted from the bottom; and having been exposed to the weather through the winter, the annual growths had separated from one another, none of which exceeded the tenth of an inch in thickness.

March 13th. A part of this having been thoroughly dried, 4 ounces were burnt, and yielded $\frac{1}{4}$th of an ounce, or $\frac{1}{16}$th of the whole, of ashes or pure earth. By this it appears, that the vegetable matter is continually dissolving, though slowly, and is carried away in the water draining from the moss: For, according to Mr Naismith's experiments in Prize Essay, pure moss, at the surface, yielded only $\frac{1}{132}$d part of its weight in ashes: In the former part of this Inquiry, the dry moss submitted to combustion yielded $\frac{1}{112}$th part of its weight in ashes, at two feet below the surface; and at five feet lower in the moss, the proportion of ashes was to the last as 5 to 4, or something less than $\frac{1}{90}$th of the burnt peat; and here the proportion of ashes in the bottom peat is $\frac{1}{16}$th; so that in the course of ages more than $\frac{7}{8}$ths of the vegetable matter is dissolved, and washed away in water. Whether the residue be soluble in the same menstruum, does not appear to be known; but it is probably very difficult of solution.

March 19th. All the flower-pots were sunk in the earth, in the open air, and left to take the weather as it came. At the same time, a part of the bottom moss, after it had been well bruised, was put into another flower-pot; and there being now three plants on each of the pots No. 1. and 3, and only two on No. 2, the two last sprung plants on the former were carefully taken up, and planted on the new flower-pot, which was marked No. 5.

May 24th. The plants on No. 1, 2, 3, 4, seemed to be nearly as thriving as they would have been on any other soil. Those on No. 1. were the most vigorous, having the most numerous and broadest leaves; those on No. 2. were the most forward, but the shoots and leaves less numerous and narrower than those of No. 1. and 3.; those on No. 3. appeared not greatly inferior to No. 1.; on No. 4. there were a good many shoots, but the leaves narrower; the plants on No. 5. had made a very small advance, and were much behind all the rest. All the pots were now packed up, in order to be carried to a considerable distance.

June 10th. After a tedious transportation, the flower-pots were unpacked. No. 4. and 5. were broken, the contents scattered and mixed, and the plants destroyed, so that all investigation with regard to them was over. No. 1, 2, 3, were again exposed to the open air, and watered when the weather was dry.

July 30th. The plants had continued to advance in growth and the ear appeared on all of them; but those on No. 2. were farthest advanced, having appeared twelve days before the other plants. The others, however, exceeded in the number and plumpness of the stalks, leaves, and ears; and the plants on No. 1. preserved all along an evident superiority over the others. Being threatened with an attack from the domestic fowls, the pots were now placed in the outside of an upper window, which unfortunately faced the north-east.

September 24th. The plants had been duly watered every second day, and were slowly advancing towards maturity; but those on No. 2. were looking dry, and seemed to be prematurely ceasing to vegetate. As they had been excluded from sun and air for 16 of the longest days, lately placed in an unfavourable exposure, and the season now far advanced, it was not expected they would become fully ripe, and therefore they were cut down this day, close by the surface, and weighed as follows.

	oz.	dr.
No. 1. had 8 full advanced stalks, from 2 grains, with large plump ears, and 9 later or abortive ones, weighing - - - - - - -	1	12
2. had 6 advanced stalks, with short ears and wrinkled grain, and one later, weighing -	0	12
3. had 7 advanced stalks, and 3 later ones, and weighed - - - - - - -	1	0

Here it must be observed that the plants No. 1. and 3. were green and juicy, and must have weighed heavier on that account. The roots of the wheat had branched out everywhere through the moss in the pots, spread around the surface, and bound it so fast together, that it was with difficulty it could be torn asunder.

October 14*th*. A few grains of the wheat of each pot having been kept, and those of No. 1. and 3. being more full of juice than those of No. 2., which were already shrivelled, each were put in a separate paper, and the whole put under one cover, and laid in a dry place, that they might become equally dry. Their proportional weight this day was—20 grains of No. 2. were equal to 12 of No. 1. and 13 of No. 3.

It has been observed by others, as a singularity in peat-moss, that the reptiles which frequent cultivated land are not to be found in it. This struck the present writer very strongly many years ago, on seeing a piece of moss turned over, which had the appearance of a fine rich black mould, yet not a single instance of the earth worm (lumbricus terrestris) was to be found in it, though this reptile abounds in all fertile soils; and even round the edges of peat-mosses, where the land water has carried earth, and the plough made encroachments, and mixed it with the moss, the earth worm, and the mole in pursuit of it, is very prevalent. As putrid vegetable matter seems evidently to be the food of this reptile, it would appear, either that the vegetable matter in rotten moss is not in a fit state of preparation for their food, or that the undecomposed substance does not afford them a suitable lodging. To try if the moss in the flower-pots, which had nourished large plants, would furnish accommodation to earth worms, a number of small ones were gathered, and a dozen put among the moss of each flower-pot, leaving them to stand in the open air. In about a week after, the flower-pots were examined, and not a single worm remained in any of them.

October 30*th*. The moss in one of the flower-pots having been well dried, was reduced to charcoal, by burning in a close vessel; and though the season for making experiments on vegetation was nearly over, the flower-pots were filled with friable mould taken from a piece of waste ground covered with grass, but had never been known to get any manure, and a quantity of peat charcoal mixed with the mould of one of the pots.—On the 10*th of November*, three grains of barley were planted on each pot, and they were placed in a warm corner of a room. The plants came up equally on both; and as soon as they appeared, they were placed in the inside of a window for the benefit of the light. The plants made slow and equal advances for several days; after which, the temperature being still moderate, and a fire always in the room, those growing over the mixture of charcoal, visibly appeared to be gaining the superiority, which became daily more discernible. They continued growing slowly till about the middle of January 1814, when the cold became so intense, that notwithstanding every precaution, the plants languished and made no more progress.—*January* 27*th*; All hope of carrying the experiment farther being at an end, the plants were cut, and weighed with a delicate balance; and those which had grown on the charcoal wanted but a little of double the weight of the other.

Such is the result of a laborious investigation respecting the qualities of that anomalous substance by which a large portion of the surface of the country is overwhelmed, and locked up from the use of society. A few other experiments were projected; but circumstances occurred which prevented them from being executed. Those which are recorded may perhaps be thought tedious, and not very interesting; but it was thought proper to give a minute account of every thing, that nothing might be wanting which could possibly throw any light on the subject. To bring the substance of what is above stated more immediately under view, the following corollaries are submitted, as a foundation to what may be farther advanced.

Cor. 1st. Notwithstanding the refractory nature of those vegetables of which peat-moss is formed, they are capable of being, partly at least, dissolved, and of nourishing cultivated plants, by the application of putrescent substances, as may be seen by the result of the experiment on flower-pot No. 1. where moss of the most refractory kind, by being steeped in cow's urine, nourished as luxuriant plants of wheat as were to be found on any soil. But it does not appear to be good economy to deprive the arable lands of a farm, or district, of putrescent manure, so indispensably necessary for the preservation of its fertility, to pour it on the neighbouring peat-mosses, with the view of exciting fertility in them. The expense of cultivating the former, which is always accessible, will be less, and the returns more certain and permanent, than can be expected from the latter. Neither can it be supposed, that such a great change can be operated on a peat-moss in its natural situation, as on a small portion of the same substance in a flower-pot. The latter was dried before being immersed in the liquid; it was sheltered from the rain for three months in winter afterwards, mellowing in stagnant air; and was kept close compressed in the flower pot.

Cor. 2d. But though putrescent substances are the most powerful solvents of peat-moss, there are others which have somewhat of a similar effect, as appears by the product of the flower-pot No. 3, which, though not equal to No. 1, was very respectable. The moss was mixed with dead sand, taken from a pit more than 6 feet under the surface, and put into the flower-pot along with the moss by alternate layers. Had the earth had more clay in it, and been more intimately mixed with the moss, so as to embrace its filaments, the effect would probably have been more considerable.

Cor. 3d. By mixing moss with the earths, in order to adapt it to the nourishment of useful plants, not only is decomposition promoted, but the consistence is also improved. That peat-moss, of itself, is a very unfit receptacle for the roots of cultivated plants, will be readily admitted. We have seen above, that it is equally unfit for the accommodation of the lumbricus terrestris. But it is not because there is a mixture of moss in the ground that this reptile shuns a place, but because the earths in which it delights are absent: for it frequents the edges of mosses in which land water has mixed these earths. As the soils in which the lumbricus abounds most are the most fertile, it is probable that such soils not only afford the greatest abundance of vegetable food, but also give the most favourable reception to the roots of cultivated plants. Hence it may be inferred, that a mixture of the earths is one of the first steps in any attempt to make peat-moss fertile.

Cor. 4th. Lime has been represented as the universal corrector of the sterility of peat-moss. By its alkaline quality, it is said to neutralize the acids, and dispose the refractory vegetable substances to putrefy. This fertilizing quality ought certainly to have operated on the moss in the flower-pot No. 2, where the force of the alkali was fully applied, by boiling the moss for a long time in plenty of lime water; yet the effect was equivocal. The plants were indeed all along the most forward; but as they were the weakest, they seem to have been most sparingly nourished, and that nourishment exhausted before they arrived at maturity. In fact, those acids with which moss is said to be stored, have not yet been detected; or if any have been found in any particular moss, they are accidental, not necessary ingredients of that substance. Caustic lime applied to moss has a tendency to harden it, rather than to dissolve it. Lime mixed in solid soils is well known to be an excellent ingredient for promoting fertility. It may also be advantageously applied on moss in which other earths have been mixed; but alone, it will have no such effect. This is well illustrated in Mr Naismith's Essay above cited, in which an experiment is recorded where moss was mixed with $\frac{1}{6}$th of lime, and no plant succeeded on it; but when a large proportion of poor earth was added, the mixture became very fertile.

Cor. 5th. The great proportion of cold stagnant water which peat-moss contains, so long as it is in its natural growing state, is the chief cause of its incapacity of producing land plants. It is shown, in the first part of this Inquiry, that at an average from the surface 7 feet down, about $\frac{5}{6}$ths of the whole mass is stagnant water. Though the solid part were of the most fertile quality, no land plant could establish its roots in such a watery mixture. But this great body of water, excluded from the genial influence of the sun's rays, by the plexus of vegetable filaments by which it is covered, and continually rising in gelid exhalation, must chill every plant requiring a mild temperature which it reaches, and spread its baneful influence over the adjacent country, affecting both animal and vegetable health. In this ftate, all attempts to cultivate the furface will be vain. The native plants may be banifhed, or their growth fufpended; but nothing but aquatic herbage can fucceed. It is therefore indifpenfably neceffary to open proper outlets, to allow this excefs of water to drain off; and thefe ought to go to the deepnefs in which the water is contained in great excefs. Unlefs where fprings arife in the bottom, deeper will be needlefs expenfe; for towards the bottom, the fubftance being more decayed and compreffed by the fuperincumbent ftrata, lies more compact, and contains lefs water; and that water can have lefs injurious effect, as being farther removed from the furface. In the mofs which has been the fubject of this Inquiry, the proportion of water was $\frac{7}{8}$ths of the whole, at 2 feet below the furface, and $\frac{1}{8}$th lefs at 5 feet lower. The water indeed efcapes very flowly through the narrow and intricate interftices among the filaments of peat-mofs; but the great excefs is perpetually oozing away, and the folid fubftance, by degrees fubfides, and becomes more compact, and thus is better adapted to undergo future operations. Nor can the withdrawing of this cold ftagnant water difqualify the mofs for retaining moifture for the fupport of vegetation. That water is always in a temperature rather hurtful than nourifhing to cultivated plants: and the power of retaining moifture fitter for the purpofe muft be communicated, by improving the confiftence, by keeping the furface level, and by making the furrows or furface drains ebb, and not more numerous than neceffary, to carry away the fuperfluous rain water.

Cor. 6th. As a mixture of earth accelerates the decomposition of moss, and makes it capable of nourishing cultivated vegetables,—as this effect is the greater as the proportion of earth is larger, and comes more fully in contact with the moss,—it would appear that the general fertility of the country would be more augmented by carrying away this substance, and preparing it as a manure for arable lands, than by cultivating it in a body. It has been fully evinced by the experience of many husbandmen, in different parts of the country, that moss, fermented according to Lord Meadowbank's instructions, when plentifully applied on thin hard soils, has greatly ameliorated them, not only improving the contexture, but furnishing abundance of vegetable aliment, and thus occasioning plentiful crops where very sparing ones had formerly been produced. And it is evident that this, in a great measure, depended on the original conformation of the moss being annihilated, and its parts separated by the fermentation, so that the particles of the soil coming more immediately in contact with those of the moss, quickly decomposed them: for the unbroken lumps in the compost remain in the ground for years unaltered; whereas that which has been rendered fine friable mould disappears in a short time. There is a great extent of poor land throughout the country, which, though at present very unproductive, is capable of great improvement; by the application of putrescent manure. But the quantity requisite to the amelioration of all the poor land is not to be had. Having recourse, therefore, to the neighbouring peat-moss, would be an excellent succedaneum. Large quantities of this substance might be thrown up in long narrow heaps, in autumn, which would moulder, and its excess of water drain away, by being thus exposed to the weather. A great bulk of this might then be easily carried to a considerable distance, for manuring all the poor arable lands in the vicinity, these lands made fertile, and the moss removed more advantageously than by the agency of water.

When we contemplate the vaſt extent of ſurface which this torpid and unſightly ſubſtance covers, much of which is in low or moderate elevations, otherwiſe well adapted to the production of corn —the baneful effects which the chilling exhalations ariſing from it produce on the ſurrounding country—and the urgent demand of an increaſing population for bread,—the general cultivation of moſs appears to be a ſubject of very momentous public concern; and perhaps no branch of the improvement of the count y has a ſtronger claim for the ſupport and patronage of the public; and it would certainly tend much, in the iſſue, to the emolument of individuals by whom ſuch grounds are held. It muſt, however, be acknowledged, that peat-moſs is not the moſt inviting ſubject of cultivation. By long neglect, the accumulations are, in many places, become enormous—its ſpongy quality forbids the eaſy application of animal force, to facilitate cultivation—and it ſhows a natural reluctance or want of propenſity to produce any of thoſe vegetables cultivated by man for his own uſe, or that of his dependent animals. This laſt poſition is ridiculed by the Reverend Dr Richardſon, (who, with ſuch generous enthuſiaſm, has widely recommended the propagation of fiorin (*agrostis stolonifera*), and pointed out peat-moſs as an eligible ſoil for that plant), and who laughs at the deſpondency of the Scotch agriculturiſts who have maintained it. But the fact is too well eſtabliſhed to be overturned by a ſarcaſm. Whatever operation may have been performed on the ſurface of peat-moſs, if no mixture of a different nature be applied, it will ſoon return to its original ſterile character. When the exceſs of water has been drawn off, heath will abundantly ſpring up; when it remains undrained, and overflowed with water, the natural *musci* and *algæ*, *eriophorum scirpus* and *anthericum*, will reſume their place, and increaſe its bulk. Neverthele ſs, moſs may be made to a certain degree fertile, and frequently with advantage to the undertaker. Much empirical inſtruction has been given to this purpoſe, by men who were either totally ignorant of the ſubject, or had formed erroneous opinions concerning it. The preceding Inquiry, imperfect as it is, may tend to communicate more correct notions, and lead to a more diſcriminate application of the various means recommended for promoting its fertility. For as the difcovery of the truth was the motive for commencing this Inquiry, fo, the ftricteft regard to truth has been obferved in the profecution of it, and giving a candid report of the refults. As it is not here intended to give a formal treatife on the culture of peat-mofs, this piece fhall now be concluded, by hazarding anfwers to fome important queries regarding that fubftance.

Query 1st. What is the caufe of the hoftility of peat-mofs to the production of cultivated plants?

Answer. It appears, from this inquiry, that they are the following:—1st, The elafticity of the fibres holds them at a diftance from one another, and leaves room for a great quantity of ftagnant water to lodge, which is, from its fituation, of a very cold temperature; and in this the feeds of land plants cannot germinate, nor their roots extend: 2dly, The diffolution of mofs is fo flow, and the diffolved matter fo foon loft in the excefs of furrounding water, that it could afford no nourifhment to land plants, even though their roots were eftablifhed. Hence the propriety of commencing the improvement of this fubject by draining, to be immediately followed by applications proper for making it more compact.

Query 2d. Is there any practicable mode by which thefe defects can be corrected?

Answer. The great excefs of water toward the furface being carried off, an important change will be operated on mofs, by the application of putrefcent fubftances. Thefe coming in contact with the vegetable filaments of which mofs is compofed, overcome their refractory nature, decompofe a part, and not only furnish ample ftore of vegetable aliment, but, by accelerating putrefaction, contribute fomewhat to the confiftence and folidity of the fubftance. But it has been already obferved, that the demand for all the putrefcent matter, liquid as well as folid, which can be collected, is too urgent for the ufe of arable land; and the effects of its application on fuch, is of too much importance to fuffer any part of it to be prudently abftracted for the cultivation of mofs. The earths, therefore, are the only probable fubftitute. The effects of the mixture of pure fand in the flower-pot No. 3. have been already noticed; and no perfon who has ever feen a peat-mofs, on which land-floods occafionally carried earth, even of the leaft fertile character, but muft have obferved the effects which it produced. The earths, by enveloping the filaments of mofs, decompofe them, and convert them into vegetable aliment; and land plants are produced in place of thofe which before covered the furface. Thus, poor earth in fome meafure performs the office of putrefcent manure upon mofs. It does more. When applied in fufficient quantity, it fills the interftices, excludes the excefs of water in rainy times, retains moifture in dry, and communicates a greater degree of confiftence, a better receptacle for the roots of cultivated plants. Since earth of fome kind is always at hand, there are few mosses which might not be covered with it at a moderate expense, after the surface was prepared for its reception ; and, after being spread, it might lye for some time to be washed into the moss by the rain ; and, by being thus intimately mixed, the fertilizing effect would be greater. The ground might then be cultivated, and be found fit for producing useful plants, and, in time, by repeated culture, become more and more productive.

Query 3d. Whether would it be most advantageous to accelerate the decomposition of the refractory upper strata of moss, or to remove them to get at what is below?

Answer. Though the noble example given by Lord Kames and some others, has made a valuable addition to the fertile surface of the country, there are few cases where that could be followed to any considerable extent, or with any prospect of defraying the heavy expense. As a general improvement, the agency of water to carry off moss is therefore altogether out of the question. Some notice of the agency of fire shall be taken in answer to query 5th. In the mean time, the application of earth, either crude or torrefied, (and that which is burnt or torrefied, and reduced to the state of brick-dust, has certainly the greatest efficacy), is the only practicable means, yet known, by which peat-moss can be made to yield subsistence to cultivated plants, and by which it can attain a consistence proper for the accommodation of their roots, and supplying them regularly with moisture. Here we have chiefly been considering moss in its most pure unalloyed state, that is, in the state most adverse to fertility ; for when it contains a sufficient mixture of the earths, it already possesses the principles of fertility, and may be cultivated, according to circumstances, as other soils, for either grass or corn ; but particularly for the former, for which it is better adapted than for the annual plants usually cultivated ; and after a few crops of these, it would perhaps be most prudent to put it in grass, and continue it so long as the grass succeeded ; and, when it failed, to repeat earthing, liming and cropping, till it was moulded into the consistence of a fertile soil. Moss could probably never be more properly employed than by laying it in permanent grass, if it can be kept productive in that state. Dr Richardson, the great advocate for fiorin, and perhaps the first discoverer of the value of that plant, recommends peat-moss as an excellent soil for producing it. But notwithstanding his seeming confidence in the fertility of that substance, he gives a substantial top-dressing of earthy compost to amend it. He seems to have had great success, and profitable returns, from the culture of this plant ; and his zeal has introduced it into Scotland : but the value of it is not so well ascertained in this country. By the report of Mr Miller of Dalswinton's culture, it appears that the ground on which the fiorin has been planted, has thereby yielded much more valuable returns ; but the report is too general, to form any judgment upon it. By the present operations of Sir James Steuart Denholm of Coltness, a fair judgment of the value of fiorin on mofs is likely to be foon obtained. This gentleman's conduct as an agriculturift merits the higheft encomium. He holds an extenfive eftate, in a high expofure, and not naturally of a very fertile quality; and for many years has, with unwearied affiduity, attended to its improvement. Every probable fcheme by which the appearance of the country can be improved, and its productivenefs increafed, he has adopted and improved; and he has now the pleafure of feeing his extenfive plantations in a thriving condition, and greatly advanced—his numerous fences in the beft order—and his fields in the moft exact culture, and productive ftate. His generous ardour, however, for the improvement of the country continues unabated. As foon as he had informed himfelf of the value of fiorin grafs, he planted a number of acres of mofs with it, which is now yielding plentiful crops. But this lying low, and furrounded with higher grounds, may be prefumed to be fcarcely a fair trial of what could be done on pure mofs. He has therefore been operating, of late, on a high lying flow mofs of confiderable extent, and has already planted about twenty acres with the fame plant. After the rough furface turf is pared off and dried, it is burnt in heaps, and the afhes fpread: the whole ris then dug over with the fpade, quite level, with ebb furface furoows, at regular diftances. The ftrings of the grafs are then laid an the furface at fmall diftances from one another, and covered with compoft made up of burnt earth prepared along the fide of the mofs, crude earth and lime. All this is executed at the rate of 12l. per acre. In October 1813, the grafs which had been planted the preceding autumn and winter had covered the ground; and, where the heaps of turf had been burnt, had grown with great vigour, in other places with lefs. Should the grafs be worth 20s. an acre per annum (and it is expected to be worth more), and continue in the fame productive ftate, the money will be very advantageoufly laid out; and this liberal agriculturift will have the merit of fetting an example which will induce many others to follow it, by which ufelefs moffes will become valuable, and the face of the country be improved.

Query 4th. Whether do fuch applications on mofs as tend to promote folidity, or fuch as increafe porofity, appear moft eligible?

Answer. It will not be denied, that the elafticity of the filaments of mofs, which makes it lye open and porous, is one great caufe of its sterility. The application of compact lying earth, has therefore been recommended, not only for promoting diffolution, but for increafing the confiftence. But all agriculturifts, from Lord Kames to the prefent day, confider lime as having a tendency to feparate the parts of too compact foils, and rendering them more friable; and for that reafon they recommend the dofe of lime to be increafed in proportion to the compactnefs of the foil. Lime, therefore, cannot be a fit application for unmixed mofs; but when there is a fufficient mixture of compact lying earth, lime will have a happy effect.

Query 5th. Can the upper ftrata of peat-mofs be advantageoufly removed by the agency of fire?

Answer. Highly combuftible as pure mofs is, it ftrongly refifts combuftion, in its native ftate, and that which lies near the furface the moft. It is not eafily dried on the damp furface, and will not take fire unlefs it be pretty dry. Even when it is dry, the combuftible fibres are fo flightly connected with one another, that it burns feebly, and the fire is apt to go out, unlefs pains be taken to keep the different pieces in contact with one another, fo as to retain the heat. Any confiderable quantity of furface mofs could not, therefore, be removed by fire, except at enormous expenfe. But, after the original conformation is broken, and the fubftance confolidated by a mixture of earth among its interftices, it becomes a very different fubject. It fometimes takes fire, without being turned up to the drought. The mixture of earth connects the combuftible matter; when heated, it retains and conducts the heat; and the burning flowly and gradually extends, often without being extinguifhed by a confiderable fhower. About the edges of moffes, where there is frequently a confiderable accumulation of this mixed matter, the burning has been known to reduce the whole to cinder and afhes, eating downward till it was ftopped by the clay at the bottom. But where only the furface of a mofs has been altered, by culture and a mixture of earth, the burning acts on the altered part, and ftops as foon as it comes to that which has undergone no change. As it is doubtful if mofs can be kept, by any means, in permanent grafs of any kind to advantage, except where it can be at intervals overflowed with land water, any mofs which had been cultivated by the application of earth, when grafs failed, might be turned over in the drought of fummer, and, after drying a few days, fet on fire. A great part of the ftirred furface would be fcorched or reduced to cinder and afhes, and be found a fit preparation for abundant crops of the plants ufually cultivated. The action of fire reduces the earth in the mixture to the ftate of brick-dust, which is known to be a powerful decompofer of peat-mofs; and a great part of the mofs to cinder, which is foluble in water, and yields plentiful nourifhment to growing vegetables, as will appear in the anfwer to the following query; and that which it completely incinerates, increafes the proportion of earth. This is not ideal. Frequent experience has evinced, that, wherever mofs, in the state defcribed, has been burnt, the most luxuriant crops have been produced. If the culture of mofs were more general, by repeating the operation of burning, plentiful crops from time to time might be obtained at a very fmall expenfe. Thus, by confuming part of the mofs at intervals, its bulk would be gradually diminifhed, and the falubrity of the air proportionally improved; and barren moffes made to produce additional quantities of provifions, nourifhed from their own bowels, and alfo manure to arable lands, inftead of abftracting it from them. Nor need this wafte of mofs be regretted. Its defects, as a fubject of cultivation for the production of ufeful vegetables, have been already noticed. Neither is it better qualified for a fubfoil. It neither poffeffes the property of an impervious fubfoil, to preferve the moifture from finking in a dry fummer, nor that of an open one, to let the excefs of water pafs downwards in a wet summer.

Query 6th. Is the cinder, or scorched part of peat, soluble in water?

Answer. Though no means have yet been discovered of making the cinder of perfect wood, pit coal, &c. soluble, the cinder of peat-moss and other plants of a feeble stem is of a different nature. The result of the experiment recorded at the close of this Inquiry, of two flower-pots filled with the same earth, into one of which a quantity of peat cinder was mixed, and was more productive than the other, shows plainly, that the cinder dissolved, and nourished the plants which grew upon it. The experiment was indeed conducted under unfavourable circumstances; but as these circumstances were the same for the plants in both flower-pots, the result is not the less decisive. The instance mentioned in the answer to the third query, where the spots in a moss which had been scorched by heaps of turf being burnt on them, were much more productive than the ground around them, is an additional proof of the solubility of moss cinder. Other proofs might be adduced; but perhaps the following, from Mr Naismith's Essay, repeatedly cited, may suffice. Having burnt a quantity of peats, he separated the cinder from the ashes, by plunging both in a vessel of water; and having put equal quantities into the midst of two flower-pots filled with river sand, he found that the plant on the cinder grew with far greater luxuriance than that on the ashes.

ADDENDA.

No. I.

Additional Appendix to Chap. XV.

On the comparative Quantities and Values of the Different Kinds of Food used among the Common People in Scotland.

By the Rev. Dr Skene Keith.

The great article of food used among the people of Scotland, was antiently meal made from oats, and barley or bigg. Both wheat and rye were used but partially; the former among the higher ranks, and the latter during the winter season, chiefly made into sour cakes or Christmas loaves among the lower classes. A small proportion of peas-meal was used in those districts in which peas were cultivated. The only vegetables in general use were cabbages and coleworts; and these were thickened with meal, and made into porridge; or the juice of them, in a boiling state, was poured on meal, and made into brose, while the cabbages or coleworts were eaten along with bread. In the winter months, the farmers' servants in the northern counties, had their *kail*, or cabbage-brose for supper; and what remained of the juice and coleworts, was next morning made into a kind of porridge, which was called *tartan purric*. As only a small quantity of these vegetables was raised, they did not save a great proportion of meal; but as milk, in the winter months, was scarce, before the introduction of the turnip husbandry, these coleworts and cabbages, boiled with a quantity of water, supplied the liquid proportion of food. In the summer months, when milk was abundant, there was a great saving of meal, especially in the Highland districts.

Now, instead of a few cabbages and coleworts, a great number of vegetables are raised; and of these, potatoes occupy the chief place in all houses, from that of the Peer, or great landholder, to the peasant or cottager. Indeed, in the pastoral districts, along the west coast, and over all the Hebrides and Northern islands, potatoes form the principal article of food for the common people for eight or nine months in the year.

Since the introduction of turnips and sown grasses, much more milk is obtained from good cows, fed with good grass in summer, and with hay and turnips in winter, than what could be got from lean cows, whose summer pasture was coarse, and who had little other food, except straw in winter. A married farm servant, who has a cow kept by his master; or an unmarried servant, who gets three chopins of milk every day, will save nearly one third part of his allowance of oatmeal, or will not use above 12 pounds in a week, while he is allowed 17½ English pounds, or two pecks Scots Troy weight of oatmeal. And if he get two Scotch pints of milk, all made into milk porridge, he will seldom use more than one half, or 8¾ths avoirdupois pounds of meal. Even when at hard work, 10½ pounds of meal will, with the above quantity of milk, fully support him.

As a proportion of butcher meat is used in all towns, and indeed in most villages, this, along with potatoes and other vegetables, is a great saving of meal. But in Scotland, in general, it is the additional quantity of milk, which both contains much palatable and wholesome nourishment, and enables the married farm-servant or day-labourer, with a few bolls of potatoes, to subsist himself, his wife, and two or three young children, without using any more meal than 2½ lib. per day, or 17½ lib. weekly.

In order to ascertain how much meal could be saved by using a greater or less proportion of milk, the writer of this paper desired his housekeeper to give his servants, for one day, nothing but milk porridge, made very thin with oatmeal, and boiled from 20 minutes to half an hour. The result was, that three men, two boys, and two women, with nine pints and three mutchkins Aberdeen measure (which is 105 cubic inches to the pint), or 971¼th cubic inches, (a trifle more than three English wine gallons), and only six pounds avoirdupois of oatmeal, were abundantly supported for 24 hours, or with breakfast, dinner, and supper. The following day, with half the quantity of milk, the same persons required 11½ pounds of oatmeal, partly in porridge, and partly in bread. This, at a time when oatmeal is high priced, would deserve attention; and by making little cheese, and using a great proportion of milk, the inhabitants of the country parishes of Scotland, might be supported very well in a calamitous season.

The usual allowance for a married farm-servant is, as above mentioned, 17½ English, or 16 Scots troy of oatmeal, with either a cow, or a weekly sum for sap or liquids. Where he uses but little milk, he requires 14 lib. weekly, or two pounds avoirdupois per day; where he has a moderate quantity of milk, he will consume 12 pounds of oatmeal; and where he has abundance of milk, and lives chiefly upon thin porridge or brose, half his allowance will serve him.

A Scots acre of oats will, at an average, raise as much oats (after deducting the seed corn) as will yield 6½ bolls, or 104 pecks, at 8¾th English pounds per peck, being the common annual allowance to a married farm servant. If the land be in high order, it will produce of potato oats, deducting as above, as much as would amount to 9¾th bolls of meal, or 18 months allowance; but the above is a fair general average, where no manure is applied to the oat crop, nor the land in very high condition.

Next to oatmeal, as already mentioned, potatoes form the most considerable portion of the food of the common people. There is a very great difference between the nourishment contained in, or the quantity of ardent spirits procured from, the Kidney or meally kinds of potato, compared to that which is got from the Ox-noble, Dutch Cluster, or Watery potato; but, in general, four pounds of potato are equal to one pound of oatmeal, differing somewhat in late seasons, when the quality of potatoes is worse, from imperfect ripening. If the hard labouring farm-servants could be subsisted on potatoes alone, a Scotch acre of potatoes would, after deducting seed, yield nourishment for man equal to that contained in 26 bolls of oatmeal, or four times as much as an acre of oats, at an average; and if dung be liberally applied, and the land in good order, would, after deducting as above, yield as much nourishment as is contained in 39 bolls of oatmeal, or four times as much as a good crop of potato oats. But in this case, there is a great expense incurred, both for dung and for labour: yet, if the same proportion of milk be allowed to four pounds of potatoes as to one pound of oatmeal, four times as many persons could be supported by an acre of potatoes as by an acre of oats. It is, however, only in those districts where fish is found in great plenty, that the common people can be supported by them and potatoes, without much oatmeal; yet, with a small quantity of the latter, and with abundance of potatoes and fish, and a moderate share of milk, the inhabitants of the Western counties and isles are maintained in health and vigour.

Meal, that is made from barley or bigg, also used with milk, makes very good porridge for women and children, or for men who do not work hard; and there is no way in which, in times of scarcity, a cottager's family can be so cheaply supported as by porridge and pot-barley, used along with milk. As the manure is chiefly applied to potatoes or bear in the Highlands, that circumstance ought to be taken into the account; but the produce of an acre, where four-rowed barley, or bigg, is usually raised, cannot be estimated higher than that of an acre of oats, because there is not nearly so much nourishment in a boll of barley meal, as in a boll of oatmeal. It is by a mixture of all these kinds of food, oatmeal only for brose, pot-barley only for broth or soup, and potatoes used in different ways, that the poor cottager or day-labourer subsists, with the greatest cheapness and economy.

As wheat can never be the principal food of the common people of Scotland, it is unnecessary to compare its produce per acre with that of oatmeal. It not only requires fallowing and manuring at a great expense, but often fails in the Northern counties; and can be raised only on good soil, or in land that is in good order: And when we compare flour with oatmeal, we must remember, that, though a finer grain, wheat is only sun-dried, and contains as much moisture in the shape of flour, as oatmeal does in bannocks or hard cakes; and therefore, that 8¼ lib. in a peck of oatmeal, would make 12 pounds of loaf bread, when baked with yeast.

In general, however, an acre of land, at an average, either in barley or oats, after deducting seed, will support a labourer, with his wife and two young children, if they have milk and vegetables, for twelve months. If the land be dunged, or in high order, it will do so for eighteen months; but an acre of wheat, from its being manured and in good order, will support double the number; and an acre of potatoes, from its manure and good hoeing, will support four times as many persons (always deducting seed) as an acre of oats or barley.

In towns and in villages where butcher meat is used, it is a question of prudence, in what proportion flour-bread, oat-meal, bear-meal and potatoes, are used with milk or with meat; as it depends entirely on their comparative prices.

On the whole, milk and vegetables, with a small proportion of meal, or animal food, are very economical, and sufficiently nourishing in the Highland districts, where there is less hard labour than in the Lowlands. But in the more improved counties, where farm-labour is severe, and carried on the year round with steady exertion, more solid food is necessary for the support of the labourer.

ADDENDA.

No. II.

Additional Appendix to Chap. XVI.

Abstract of the Constitution and Objects of the Chartered Bank, called "The British Linen Company."

The British Linen Company was incorporated by a royal charter, immediately after the Rebellion of 1745, when the great desire of Government was, to introduce habits of industry into Scotland, as the most effectual means of securing the affections of the people to the established government. It was planned and directed by the same patriotic individuals, who had proposed the institution of the Board of Trustees, for the encouragement and improvement of manufactures; and it had the good fortune to be directed, for many years, by those eminent persons, by whom the duties of that Board were most assiduously performed, amongst whom were, Archibald Duke of Argyle, Lord Justice-Clerk Fletcher, Lord Tinwald, and Baron Maule.

At first it was supposed, that the object of this institution would be attained, chiefly, by the Company itself engaging in the manufacture and sale of Linen: But this was only *one* of the means by which it was hoped the Company might accomplish the great design for which it was constituted. The object in view, indeed, was a very extensive one, that of co-operating with the Board of Trade, not only in promoting the linen manufacture, which was considered to be the staple of Scotland, but also the general improvement of the country. This, it was believed, would be best accomplished by means of a paper circulation, and the other operations of banking. Instead of continuing, therefore, as manufacturers or dealers, the Company, for a period of more than sixty years, have confined their business entirely to that of banking; and have applied the large funds, and the credit which they possessed, towards promoting trade, manufactures, and agriculture, all over Scotland. The change which was thus made in the direction of the Company's employment of their Capital, has not only been felt by the public as a benefit, but has likewise been sanctioned by the approbation of Parliament, and in particular by the 48th of the King, cap. 149, sections 16, 17, and 19, by which certain privileges are granted to them as a Banking Company, along with the Bank of England, Bank of Scotland, and Royal Bank.

By their original charter in 1746, the capital of the Company was 100,000*l.* By another royal charter in 1806, it was increased to 200,000*l.*; and by their charter in 1813, it is now 500,000*l.*

Besides their head office at Edinburgh, the Company have long had establishments in the principal towns in Scotland. In 1808, they had branches in the following towns, viz. Leith, Cupar, Dunfermline, Montrose, Inverness, Forres, Elgin, Glasgow, Dumfries, Hawick, Jedburgh, Dunse, Dunbar, Newton-Stewart, and Perth, which are all specified in the 48th of the King, cap. 149.; and they have since established branches at Dundee, Stranraer, and Tain.

The business of the Company is now confined to dealing in bills of exchange, giving cash credits, and receiving deposits of money, for which they in general allow 4 *per cent.* interest. In all their payments, they circulate their bank-notes, payable on demand. They also remit to London, a share of the public revenue of Scotland, along with the other banks.—But as their business, on the whole, is carried on in the same manner as that of the other two chartered banks, it seems unnecessary to give a more particular description of it, in this place.

The partners of the Company, in terms of their charters, elect annually, on the first Monday in March, a Governor, Deputy-Governor, and five Directors: At present the officers of the Company consist of a Manager and Secretary, two Accountants, and 23 Clerks; besides their agents and clerks in the country.

The Company's stock sells at the rate of 212*l.* *per cent.*

FINIS.

D. Willison, printer, Edinburgh.

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