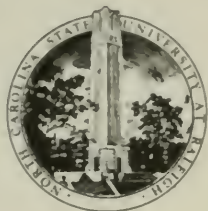


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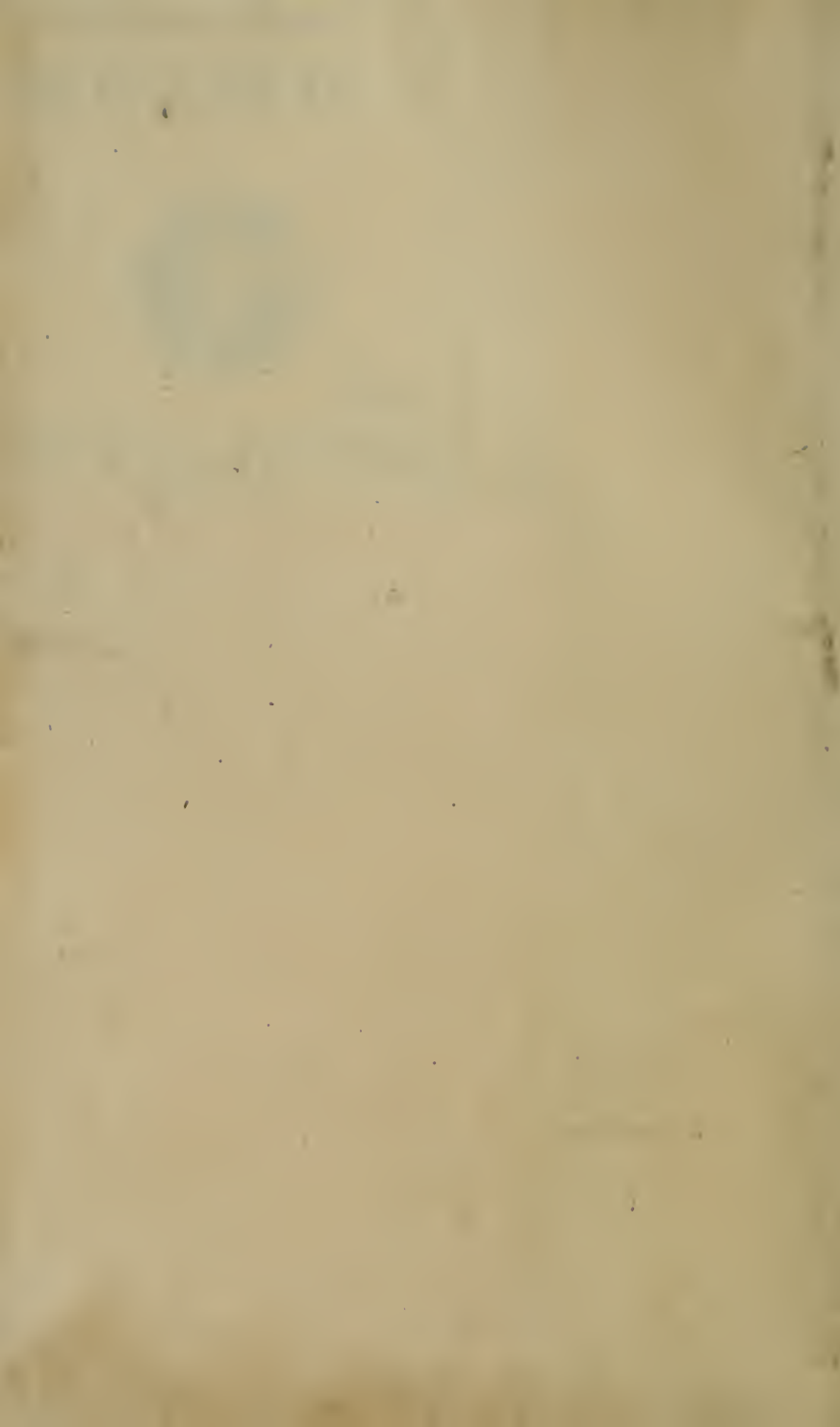
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A
TREATISE
ON
AGRICULTURE
AND
RURAL AFFAIRS.

BY
ROBERT BROWN,
FARMER AT MARKLE, COUNTY OF HADDINGTON.

Multum adhuc restat operis, multumque restabit; nec ulli nato post mille sæcula præcluditur occasio aliquid adjiciendi.—PLINY.

The poor husbandman who lives honestly, and cultivates his land industriously, is better than a proud philosopher, who neglects himself, and studies the motions of the heavenly bodies.—THOMAS A KEMPIS.

VOLUME FIRST.

EDINBURGH:

PRINTED FOR OLIPHANT, WAUGH, AND INNES,
EDINBURGH; AND LONGMAN, HURST, REES, ORME,
AND BROWN, LONDON.

1811.

TO THE RIGHT HONOURABLE

SIR JOHN SINCLAIR OF ULBSTER, BART.

PRESIDENT OF THE BOARD OF AGRICULTURE.

S I R,

THE following Treatise on Rural Affairs is ushered into the world under the sanction of your name. That favour I was encouraged to solicit not only from a remembrance of many former ones; but also from a sense of the value of your patronage to every one who attempts to investigate the rural economy of the British Isles. Independent of these considerations, this publication could not, with propriety, be committed to the protection of any other person than of HIM who first turned the author's attention to the subjects which it embraces.

It is now more than sixteen years since I had the honour of being known to you, during which period, I have enjoyed numerous opportunities of ascertaining the ardency of your zeal to benefit the Public by promoting the internal improvement of the country. Often have I admired the wisdom of your measures, and the steady perseverance displayed in bringing them to a happy issue. Obstacles might retard their success for a time, but these obstacles could neither damp your ardour, nor cause you to lose sight, for a moment, of the objects you had in contemplation. Perseverance is rarely bestowed upon great geniuses; but, fortunately for the public, you are gifted with a stock of this quality sufficient to remove difficulties of the greatest magnitude.

Were I to attempt a detail of the numerous plans you have brought forward for advancing the prosperity of the British empire, this address would be lengthened beyond reasonable bounds; while, after all, such an attempt would not, in all probability, bring me one step nearer to the object I have in view by thus publicly ad-

addressing you. It is impossible, however, to refrain altogether from noticing your endeavours to serve the public, lest it may be thought I am insensible of their merits. Let me only state that the British Wool Society was instituted under your patronage, and that the Highland Society, since the day it was established, has constantly experienced your assiduous support. But the Statistical Account of Scotland alone, even had no more been done by its author, was sufficient to immortalize the name of him who conducted it. I well remember that, at the commencement of that work, many people considered it as an undertaking which would never be finished; but you soon satisfied them of their mistake, and proved to the world that the difficulty of the task served only to increase the force of your exertions.

When the Board of Agriculture was established, no such doubts were entertained. The public, in general, were by that time convinced, that no practicable undertaking could remain unfinished in your hands, therefore believed you would not rest satisfied till a complete survey of

the island was accomplished. This, to the surprise of the whole world, was brought about in little more than twelve months from its commencement, whereby a mass of rural information was given to the public, which may be said to exceed the accumulated stores of any other nation. Though this great work was executed under the authority of a Board composed of the most illustrious characters in the kingdom, yet it is consistent with my personal knowledge, that the labouring oar was almost solely under your guidance and direction. You instructed the surveyors, you managed the whole correspondence, and you used the most appropriate means for bringing the whole business to a speedy and successful conclusion.

Whether the benefits sanguinely expected by many agriculturists from the institution of the Board have been fully realized shall not, at this time, be enquired into; but, if the measures of that establishment have not always been successful, no person ever thought of blaming you on that account. On the contrary, your active and disinterested conduct merited, and always

received the greatest praise. In fact, you brought the study of agriculture into fashion, and introduced a change of system, which promises, at no distant day, to convert into a science what has hitherto been considered only as an art imperfectly understood, and conducted upon no fixed principles.

Such being my sentiments concerning the merits of your public life, I must feel much gratification in being permitted to usher these volumes into the world under the sanction of your authority; and trust, when it is known that the principles upon which they are executed are in unison with those held by you on the chief branches of rural economy, a degree of success will be procured not to have been expected had that sanction been withheld.

I have the honour to be,

Your Faithful Servant,

ROBERT BROWN.

MARKLE, }
10th March 1811. }

PREFACE.

THE following Treatise on AGRICULTURE and RURAL AFFAIRS is presented to the Public with considerable diffidence, the author being well aware how difficult it was to bring forward any thing new, or worthy of attention, upon subjects already investigated and discussed by so many writers. The substance of the Treatise having, however, been originally published in that popular work, the Edinburgh Encyclopaedia, where it met with a favourable reception, the Author was induced, by the Publishers of that Work, to revise what was there given under the head of AGRICULTURE, and to enlarge several of the Chapters

and Sections, so as the whole might appear somewhat in a regular shape. Of the many errors fallen into when executing that task no person can be more sensible than the Author himself; though he humbly hopes that few of these errors are of such a nature as to mar the sense materially, or prevent the meaning of what is stated from being sufficiently understood. If he is mistaken in these points; if he is arraigned at the bar of the public tribunal, and condemned by those who sit in judgment upon literary undertakings for having executed the Work imperfectly, he must of course submit to such censure as may be bestowed. But, should the opinion of practical agriculturists be in his favour; should the principles upon which the Work is written meet with their approbation; and, above all, should the practical details be countenanced and supported by those most capable of determining upon their merits, the Author will pay little

attention either to the scoffs or calumnies of persons of a different description.

THE reader is desired to attend, that where the word *acre* is used without any explanation, the Scotch acre, which is above one-fifth larger than the English acre, is always meant. Likewise, that 16 lbs. avoirdupois is to be understood as the contents of a stone weight, except when the term applies to the produce of land in Scotland, as more particularly described in the section upon weights and measures. With regard to measures of capacity, it is enough to say, that the Linlithgow boll of wheat and peas is a trifle larger than four Winchester bushels; and that the Linlithgow boll of oats and barley contains nearly six and one-fourth bushels of Winchester measure.

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1898

ON THE PROGRESS OF THE ARTS AND MANUFACTURES

TABLE I

Year	Value of Manufactures	Value of Exports	Value of Imports	Total Value
1897	1,000,000,000	200,000,000	100,000,000	1,300,000,000
1898	1,100,000,000	220,000,000	110,000,000	1,420,000,000
1899	1,200,000,000	240,000,000	120,000,000	1,540,000,000
1900	1,300,000,000	260,000,000	130,000,000	1,660,000,000
1901	1,400,000,000	280,000,000	140,000,000	1,780,000,000
1902	1,500,000,000	300,000,000	150,000,000	1,900,000,000
1903	1,600,000,000	320,000,000	160,000,000	2,020,000,000
1904	1,700,000,000	340,000,000	170,000,000	2,140,000,000
1905	1,800,000,000	360,000,000	180,000,000	2,260,000,000
1906	1,900,000,000	380,000,000	190,000,000	2,380,000,000
1907	2,000,000,000	400,000,000	200,000,000	2,500,000,000
1908	2,100,000,000	420,000,000	210,000,000	2,620,000,000
1909	2,200,000,000	440,000,000	220,000,000	2,740,000,000
1910	2,300,000,000	460,000,000	230,000,000	2,860,000,000
1911	2,400,000,000	480,000,000	240,000,000	2,980,000,000
1912	2,500,000,000	500,000,000	250,000,000	3,100,000,000
1913	2,600,000,000	520,000,000	260,000,000	3,220,000,000
1914	2,700,000,000	540,000,000	270,000,000	3,340,000,000
1915	2,800,000,000	560,000,000	280,000,000	3,460,000,000
1916	2,900,000,000	580,000,000	290,000,000	3,580,000,000
1917	3,000,000,000	600,000,000	300,000,000	3,700,000,000
1918	3,100,000,000	620,000,000	310,000,000	3,820,000,000
1919	3,200,000,000	640,000,000	320,000,000	3,940,000,000
1920	3,300,000,000	660,000,000	330,000,000	4,060,000,000
1921	3,400,000,000	680,000,000	340,000,000	4,180,000,000
1922	3,500,000,000	700,000,000	350,000,000	4,300,000,000
1923	3,600,000,000	720,000,000	360,000,000	4,420,000,000
1924	3,700,000,000	740,000,000	370,000,000	4,540,000,000
1925	3,800,000,000	760,000,000	380,000,000	4,660,000,000
1926	3,900,000,000	780,000,000	390,000,000	4,780,000,000
1927	4,000,000,000	800,000,000	400,000,000	4,900,000,000
1928	4,100,000,000	820,000,000	410,000,000	5,020,000,000
1929	4,200,000,000	840,000,000	420,000,000	5,140,000,000
1930	4,300,000,000	860,000,000	430,000,000	5,260,000,000
1931	4,400,000,000	880,000,000	440,000,000	5,380,000,000
1932	4,500,000,000	900,000,000	450,000,000	5,500,000,000
1933	4,600,000,000	920,000,000	460,000,000	5,620,000,000
1934	4,700,000,000	940,000,000	470,000,000	5,740,000,000
1935	4,800,000,000	960,000,000	480,000,000	5,860,000,000
1936	4,900,000,000	980,000,000	490,000,000	5,980,000,000
1937	5,000,000,000	1,000,000,000	500,000,000	6,100,000,000
1938	5,100,000,000	1,020,000,000	510,000,000	6,220,000,000
1939	5,200,000,000	1,040,000,000	520,000,000	6,340,000,000
1940	5,300,000,000	1,060,000,000	530,000,000	6,460,000,000
1941	5,400,000,000	1,080,000,000	540,000,000	6,580,000,000
1942	5,500,000,000	1,100,000,000	550,000,000	6,700,000,000
1943	5,600,000,000	1,120,000,000	560,000,000	6,820,000,000
1944	5,700,000,000	1,140,000,000	570,000,000	6,940,000,000
1945	5,800,000,000	1,160,000,000	580,000,000	7,060,000,000
1946	5,900,000,000	1,180,000,000	590,000,000	7,180,000,000
1947	6,000,000,000	1,200,000,000	600,000,000	7,300,000,000
1948	6,100,000,000	1,220,000,000	610,000,000	7,420,000,000
1949	6,200,000,000	1,240,000,000	620,000,000	7,540,000,000
1950	6,300,000,000	1,260,000,000	630,000,000	7,660,000,000

TREATISE
ON
RURAL AFFAIRS.

INTRODUCTION.

AGRICULTURE claims a pre-eminence above manufactures and commerce, from its seniority and superior usefulness; and, to use an expression of the celebrated SULLY, may be regarded as one of the breasts from which the state derives its support and nourishment. Manufactures and commerce originally owed their existence to agriculture; and the people employed in carrying them on are constantly fed by those engaged in the parent art. Agriculture, therefore, may be considered as of the first importance to mankind; because their temporal welfare and prosperity depend upon receiving a regular and suffi-

cient supply of the various articles cultivated by the agriculturist.

IN an age like the present, when the utility of agriculture is so fully recognised, it is unnecessary to insist at any length upon the advantages enjoyed by every nation, in which that art is sufficiently understood, and skilfully practised. The territory, possessed by any people, is the original property, or capital stock, from which they are supplied, not only with the necessaries, but also with the comforts of life; and in direct proportion as their territory is improved, their prosperity will be advanced. It is from the surface of the earth, that timber, cordage, and sails are procured for our navy; and that flax and wool, hydes and tallow, madder and other dye-stuffs, are obtained for home and foreign consumption. If we penetrate into the interior parts of the earth, we find either limestone, marl, or other substances for invigorating the surface, and rendering it constantly prolific. It is likewise from the bowels of the earth, that copper, lead, tin, iron, and coals, are procured, and employment given to another part of the community. But the remark, which of all others deserves attention,

is; that it is only by cultivating the soil, and raising as large a store of provisions as possible, that labourers, manufacturers, and artisans, can live comfortably, or proceed with spirit in their several occupations.

THE utility of agriculture will appear from the following considerations:—In the *first* place, where agriculture is neglected, population must be scanty, because the necessaries of life are wanting; and the great body of the people must be miserable, because regular employment cannot be furnished to them. Perhaps at no period has husbandry been more perfectly cultivated in Great Britain, than at the present; hence the lower ranks are better paid, better fed, better clothed, and in every respect more comfortably situate, than in former times. To territorial improvement may also be attributed the increased and increasing strength of the British empire, and the capability of sustaining burdens, which, not twenty years ago, would have ruined every description of its inhabitants. But, by the extension of agricultural improvement, by the meliorations made on the capital stock of the country, the numbers of the people have increased, manu-

factures have prospered, and both inland and foreign commerce have been carried on with vigour and success.

IN the *second* place, were not agriculture carried on as a separate trade, and a quantity of provisions thereby raised, which exceeded the wants of agriculturists, not only would every other art be at a stand, but every science, and every kind of mental improvement, would be neglected. 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, or 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 are placed beyond the necessity of manual la-

bour to procure these necessaries, that the powers of the mind develope themselves, and shew 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.

WE think it unnecessary to offer any apology for the plan adopted in this Treatise, and for having deviated from the path generally followed by those who have preceded us in similar undertakings. It has been our object, as much as possible, to treat the different subjects before us rather in a practical than a theoretical manner, and to avoid all discussion that did not tend to promote some useful purpose. Perhaps we have insisted at greater length upon the moral excitements to improvement, than by some may be thought necessary; but a firm conviction of the importance of such excitements induced us to illustrate them as fully as possible.

HISTORY
OF
AGRICULTURE.

THOUGH Agriculture may be considered as of great antiquity, and in some respects as coeval with the first formation of society, yet materials are wanting, from which a progressive history of the art can be composed. It is probable, however, that mankind, in the early ages, derived their subsistence from hunting in the forests, and fishing in the rivers, and from the milk and flesh of such domestic animals as they possessed ; but how long they continued in this situation, it is impossible to conjecture. From the sacred writings, however, we learn that hus:

bandry was understood by Noah, who of course taught it to his sons, by whom it is likely the art was spread over the world. The history of the ancient Egyptians informs us, that they were well acquainted with agriculture ; and perhaps the people of Italy, under the Roman government, understood all the branches of husbandry much better, and practised them more successfully, than the present inhabitants of that country. There is sufficient authority for maintaining, that an enlightened system of rural economy was prevalent during the Augustan age, and perhaps long before ; indeed the Georgics of Virgil, and other productions of the Roman authors, shew, that husbandry was not only well understood by the Romans, but correctly and successfully practised.

IN Britain, at the period of the Roman invasion, there is reason to presume, that husbandry was hardly known, except in the southern districts ; and that, even in these, it was very imperfectly executed. But whatever might be the situation of Britain when invaded by the Romans, it is certain, that the husbandry of the island, from the Lands-End to the Firth of Forth, was greatly improved

by the Roman soldiers; and that all the grains, now cultivated, were then raised to a considerable extent. In support of this assertion, could the smallest doubt be entertained of its truth, we might refer to the immense quantities of grain exported from Britain when in possession of the Romans, and the obvious marks of improvement left by that celebrated people when they quitted the island. The Roman conquests, instead of desolating the earth, as has often been the case in similar instances, insured the improvement of every country that was subdued; and the soldiers of that nation, being drawn from the plough, spread a knowledge of husbandry through every country which came under their dominion. To benefit mankind, and increase their comfort and happiness, seemed to be the invariable wishes of the Roman commanders. They seldom or never burned or laid waste the country which they conquered, but rather strained every nerve to civilise the inhabitants, and to introduce the arts necessary for promoting their comfort and happiness. To facilitate communication from one district and town to another, seems to have been a primary object with the Romans; and many works of this kind, accomplished by them, are still dis-

cernible in numerous places. By thus employing their troops, when not engaged in more active service, the Roman commanders had greatly the advantage over our modern generals. Instead of suffering their soldiers to loiter in camps, or riot in towns, thus enervating their strength and relaxing their morals, the Roman commanders kept them regularly at work, and, what was still better, at work on objects highly beneficial to the interests of those whom they subjugated.

WHEN the Romans finally withdrew from Britain, the country southward of the Firth of Forth had attained a considerable degree of cultivation and improvement; but it does not appear, that the inhabitants had acquired much of the martial spirit of their former masters and instructors. The further progress of improvement, however, was soon obstructed, particularly in the districts between the two walls, by the ravages of the northern tribes, known, at that time, under the names of the Maætæ and the Caledonians. These fierce plunderers prevailed so far over the unhappy Britons, as to induce that enervated people to invite the Saxons to their assistance, who, in their turn, became masters of the greatest part

of the island. Excepting Wales, and the western part of Scotland, then known under the name of Strath Cluyid, the whole island, south of the Firth of Forth, continued in the possession of the Saxons for several centuries.

BUT the state of South Britain was not completely settled till the Norman invasion, when customs and habits were introduced, which, to this day, remain too firmly established, to be removed without the special interposition of the legislature. To his Norman barons, William the Conqueror assigned great estates almost in every county, as a reward of their services; and these grants were afterwards enlarged, when forfeitures occurred from the rebellion of the old Saxon possessors. The estates so bestowed were, by the great barons, or officers, in some measure divided among their retainers, or dependents, under the burden of military service; and in this way feudal tenure was introduced, and formed into a regular system.

THE Saxon government was favourable to internal improvement, or rather it continued the system introduced by the Romans; but the Nor-

man conquest, by introducing the feudal system, checked the progress of cultivation, and contributed to the decline of husbandry. From the Conquest to the days of Henry VIII. the practice of agriculture received little improvement; and as for theoretical, or scientific knowledge, there is not the slightest vestige of any being acquired, or even sought after, during the long period of five centuries. To the haughty feudal baron, who reigned in a castle, and was provided with an abundant supply of the necessaries of life from his extensive domains, the improvement of the country was a trifling object; and as his dependents held by military tenure, they considered husbandry as unworthy of their notice. Hence agriculture was carried on only by the lowest of the people, and, in such hands, the art necessarily declined. The unhappy wars between the houses of York and Lancaster gave husbandry also a severe shock, one half of the country being desolated and laid waste by the contending factions.

Sir Anthony Fitzherbert, one of the judges in the court of common pleas, is the first person on record who attempted to enlighten English

husbandmen, by writing on the art of agriculture. In 1534, he published a treatise called *The Book of Husbandry*, and another in 1539, entitled, *The Book of Surveying and Improvement*. The Book of Husbandry contains minute directions for ploughing, managng, and cropping land, together with a full account of the diseases which affect horses and other animals, and the method of curing them. The Book of Surveying relates to castles, woods, parks, mills, and other branches of property; and also contains numerous advices concerning the best way of improving arable land.

Sir Anthony Fitzherbert, laying it down as a primary principle, that the majority of husbandmen live by the plough, describes the several implements generally used in his time for tilling the ground. He then points out the other articles that belong to a team of horses; and, when speaking of carts and waggons, very properly recommends that the wheels on which they are mounted should be shoed or bound about with iron; whence it may be inferred, that wheels altogether composed of wood were at that time commonly used. It would appear, that husband-

men, in Fitzherbert's days, combined a knowledge of every profession; for among the appendages of a plough, we find an axe, hatchet, hedge-bill, auger, flail, spade, and shovel, particularly enumerated. It is also recommended, that young husbandmen should learn to make their *yokes, oxbows, stools*, and all manner of plough *geare*, lest the purchase of these articles should be too costly for them. Fitzherbert seems to have preferred oxen above horses in executing rural labour, though he frankly admits that horses will go faster than oxen on even and light ground, and that they are quicker for all sorts of carriage work.

AN hundred years, however, elapsed, after the publication of Sir Anthony Fitzherbert's book, before any thing further appeared really deserving the attention of husbandmen. During the commonwealth, a period favourable to genius and enterprise, and when numbers of persons appeared upon the stage, whose names would never have been heard of had not a change of government occurred, Walter Blythe, Gabriel Plattes, and other enlightened men, illustrated the art of husbandry in the most satisfactory

manner. Blythe's writings, in particular, contain a great deal of sound sense, and not badly expressed, on almost every branch of husbandry: The first part of his *Improver Improved*, published 1652, contains what he calls six pieces of improvement: 1. On floating and watering land; 2. On draining fen and boggy land, and regaining land from the sea; 3. On such inclosures as prevent depopulation, and advance all interests; 4. On tillage of land kept too long in grass; and pasturing others destroyed with ploughing; 5. Discovery of all soils and composts, with their nature and use; 6. On doubling the growth of wood by new plantations.—The second part contains six newer pieces of improvement: 1. On the husbandry of clover and St Foyne; 2. On lessening the charge and burthen of the plough, with divers figures thereof; 3. On planting wild woad and madder; 4. On planting hops, saffron, and liquorice; 5. On planting of rape, coleseed, hemp, and flax, and the profit thereof; 6. On the great advance of land by divers orchard and garden fruits. Bating the dedication to my Lord Protector, and other public bodies, the whole of the *Improver Improved* (now become a scarce book) might be reprinted with manifest

advantage. Blythe's principles, which are very correct, may be ascertained by perusing the first chapter of his Fourth Piece of Improvement, wherein he directs how to plough and crop old pasture land.

IN this chapter, Mr Blythe shews, in forcible terms, the immense benefit which would accrue to the country from breaking up old pasture lands, and proves, in a satisfactory manner, that constant pasturage is highly detrimental to the interest of proprietors and occupiers. His sentiments are correct, and very applicable to the rural system of many English counties at the present day. They apply, in fact, to the husbandry of all the midland counties, and, generally speaking, to the whole of England, the counties of Northumberland, Norfolk, Suffolk, Essex, and Kent excepted. In the last mentioned counties, old pastures, except in situations opposite to the houses of gentlemen, are not numerous, though alternate husbandry, or changing from grass to corn, and *vice versa*, is not regularly followed.

BLYTHE seems to have entertained just views of the benefits accompanying alternate husbandry,

as he demonstrates, in strong language, the numerous advantages of such a system. In fact, all sour, rushy, or clay soils, should be frequently broken up by the plough, and exposed to atmospheric influence. Grasses upon such soils thrive best at first, and gradually fall off in after seasons. To keep soils of these descriptions constantly in grass, is therefore detrimental to the public interest, because produce of every kind is thereby greatly lessened. Were such fields renovated by tillage, and, after being cropped five or six years, sown down with grass seeds, along with the crop of grain succeeding a summer fallow, incalculable damages would follow both to the public and individuals.

ON the other hand, Mr Blythe appears to have possessed an accurate notion of the evils flowing from over ploughing, or, in other words, from keeping land constantly under tillage, a system too prevalent, even now, in many English counties. In his time, as well as at present, a very large portion of English soil was regularly subjected to the plough, and of course worn out and exhausted by constant tillage. A system of this nature has prevailed upon the open and common

lands of England since the days of William the Conqueror, and must remain in force till some strong measure is adopted by the legislature of the country capable of putting an end to it. In short, the losses sustained from constant pasturage of a great part of the soil, and constant tillage of the remainder, are as correctly ascertained and described by Blythe as by any of our modern, and, apparently, more enlightened writers.

AFTER the Restoration, various improvements were brought to England by the refugees, who had resided on the continent during the government of the commonwealth. It has been generally understood, that Sir Richard Weston, one of these refugees, introduced clover; but it is certain that this valuable variety of grass was sown in England before that period; for Blythe treats both of it and St Foyne in a systematic manner. It is more likely that turnips were then first cultivated; because Blythe does not say a single word concerning this valuable esculent, the introduction of which occasioned almost a total change in the English agricultural system in so far as related to the management of light soils.

BEFORE clover and turnips were cultivated on a great scale, the husbandry of Britain was necessarily imperfect. The scourging crops much exceeded the meliorating ones ; of course the produce of the ground was considerably inferior in quantity to what it is now, whilst a great loss was sustained by the public from not receiving through the whole year a regular supply of butcher meat, with which they are now fortunately provided. Another disadvantage, accompanying the old system, was, that light soils could rarely be cleaned without suffering them to remain unproductive for a year, when under summer fallow ; whereas, since turnips were introduced, these soils are much more effectually cleaned than formerly, whilst a valuable crop is obtained in the same year. Summer fallow has long been extensively practised in England, and at this day perhaps more so than necessary, especially upon common field land, as will be more particularly noticed in another place. With all fields held in severalty, the introduction of clover and turnips proved of singular advantage, not only in a private, but also in a public point of view. A judicious rotation of cropping can thereby be exercised, and one culmiferous crop

need not follow another, which could not formerly be avoided ; whilst the culture of leguminous crops enriches the soil, increases the stock of manure for rendering it productive, and furnishes the means of supplying the markets with fat cattle and sheep through every month of the year.

THE improvement of the English rural system was in some degree promoted by the exertions of Jethro Tull, an inventive genius, who possessed more imagination than solid sense to direct it. By him the drilling or row system of husbandry was brought into practice ; and so eager was he in its support, as to neglect the impracticability of executing it in numberless situations. But the strongest proof, that the imagination of Tull was more brilliant than his judgement was profound, may be gathered from his hostility to manures, and from his substituting additional tillage in their place. The doctrines of Tull, however, like those of every plausible theorist, were adopted by several people ; and, to a certain extent, are even fashionable at this day. The utility, nay, the necessity of manures, is now acknowledged by all persons ; but his plan of drilling every

kind of grain continues to be supported, though it is demonstrable that this mode of sowing is chiefly applicable to leguminous crops ; and only in a few soils and situations practicable with culmiferous ones.

THE plan of cultivating the fields in the regular manner followed in garden husbandry, is no doubt very desirable, did circumstances suffer it to be executed ; but we are apprehensive that physical impediments are in the way of such a plan, not easily to be removed. These shall be noticed in the section where Drill-Husbandry is treated of.

LITTLE further alteration in the rural economy of England occurred, except in the superior attention bestowed on live-stock, by Mr Bakewell and others, till the establishment of the national Board of Agriculture, under the auspices of Sir John Sinclair, Baronet, when a general desire seized all ranks to promote internal improvements. Hartlib, a century and a half before, and Lord Kames, in his Gentleman Farmer, had pointed out the utility of such an establishment ; but it was left to Sir John Sinclair to carry it into

execution. To the unwearied endeavours of Sir John are the public indebted for this admirable institution, which has certainly done much good, and may still do a great deal more. Two advantages, among many, may be mentioned: 1st, A great number of new men were brought forward by the Board, whose names the public would probably otherwise never have heard of; and these being chiefly practical people, professionally concerned in farm-management, agriculture, by their endeavours, was rescued from the hands of theorists, and a revolution of no small extent accomplished in rural affairs: 2dly, Before the Board was instituted, the bond of connection betwixt agriculturists was slender, and served few useful purposes. Each trusted to his own information, and knew little more about the practices of conterminous districts, than of those of China or the most distant countries. The establishment of the Board removed at once all these evils and difficulties. A common fortress, erected for the benefit of all agriculturists, and to which each might resort for advice and protection, was immediately recognised. Farmers, who resided in the most distant quarters of the kingdom were made acquainted with one another; and, by the

publications of the Board, a rapid dissemination of knowledge took place amongst the whole profession. The art of agriculture was brought into fashion; old practices were amended; new ones introduced; and a degree of exertion manifested, which had never before been exemplified in this island.

THE numerous agricultural surveys, executed under the authority of the Board, were also of singular advantage, as they brought to light the practice of every county; and, while they pointed out the obstacles which lay in the way of improvement, the most effectual methods of removing them were likewise explained and elucidated. The very collision of argument occasioned by such discussions, incited agriculturists to investigate the principles of the art which they professed, and induced them to search after new channels of improvement.

THAT the first measure adopted by the Board, viz a general survey of the whole island, was a useful one, has been acknowledged by every person; but doubts have been entertained by many, concerning the utility of several subsequent measures, which deserves some consideration. It has been

urged, and with some degree of truth, that the endeavours of a public Board should be limited to objects which exceed the powers of an individual to accomplish ; and that a Board, composed of materials like the present one, ought never to interfere with the minutiae or practice of farming, but leave these matters entirely to the management or direction of those by whom the art is exercised. Under these impressions, it has been stated, that the Board were discharging their duty, when they recommended to Parliament a division of common field and waste land ; and, in like manner, that their efforts would constantly be of advantage, when directed to a removal of every obstruction to improvement which required legislative interference. A recommendation from a public board carries a weight with it, insuring a degree of success not to be obtained by the petition or complaint of one or two individuals. Hence the propriety of originating, at the Board of Agriculture, all laws and regulations influencing or operating upon rural economy seems apparent, because the members of such a Board may reasonably be supposed to possess a degree of knowledge in rural science, rendering

them sufficiently qualified to judge of, and to determine upon, the measures to be adopted.

BUT, on the other hand, it has been urged, that the practice of husbandry ought not to be included in their deliberations ; and that every thing of that kind may safely be left to professional people, who are morally and physically better qualified to investigate and ascertain what is fit and proper to be executed. It has been further urged, that when a Board of Trade acted in this country, its measures were confined to the great and leading objects of commerce, without descending to minutiae, or interfering with the business of individuals. In short, it has been supposed almost as preposterous for the Board of Agriculture to meddle with ploughing, sowing, planting potatoes, building cottages, &c. &c. as it would have been for the Board of Trade to issue directions to apprentices concerning the best way of folding and tying parcels. Though inclined to think there is some weight in the arguments urged, we adhere to the opinion already given, that much good has been done by the Board, and that a great deal more may still be accomplished. The scantiness of their funds, however, is a reproach to the nation, and calls

loudly for additional aid to such a meritorious establishment. If the generous spirit which animated the Persian kings had pervaded our rulers when the Board was established, or even had the latter estimated agriculture of the same value as it was appreciated by the former, a complaint of this kind would have been superfluous. At the annual festival in April each year, in honour of agriculture, the Persian king was in use to address the farmers to the following effect : “ I am one of you. My subsistence, and that of my people, rests on the labour of your hands ; the succession of the race of man depends on the plough, and without you we cannot exist. But your dependence upon me is reciprocal. We ought therefore to be brothers, and live in perpetual harmony.”

WE now come to this northern part of the island, where husbandry was long unknown, and still longer imperfectly exercised. There is sufficient evidence, that husbandry was introduced into Britain at the south-east corner, and travelled, by slow and gradual steps, to other quarters ; but it is difficult to trace the progress of the art, or to discover how far it had advanced

when this island was evacuated by the Romans. When Severus invaded Scotland, A. D. 207, we are told that the Maæatæ and Caledonians, who possessed all the island beyond Hadrian's Wall, inhabited barren uncultivated mountains, or desert marshy plains; that they had neither towns nor cultivated lands, but lived on the milk and flesh of their flocks and herds, on what they got by plunder, or caught by hunting, and on the fruit of trees. These barbarous nations, however, being obliged by Severus to yield up a part of their country to the Romans, that industrious people, in the course of the third century, built several towns and stations, constructed highways, cut down woods, drained marshes, and introduced agriculture into the districts south of the Firth of Forth, which are generally well calculated for tillage. Though the Romans never formed any lasting station north of the Forth, yet many of them and of the provincial Britons retired into Caledonia at different times, particularly about the end of the third century, to escape from the Dioclesian persecution. It is probable these refugees instructed the natives; and as the eastern coast of Caledonia was also well adapted for cultivation, there is little doubt but that the

Pictish nation, who inhabited it, were early initiated into the art of agriculture.

TILL the reign of Malcolm Canmore, in the eleventh century, the progress of husbandry was very slow; but during his reign, a greater degree of attention seems to have been paid to the cultivation of the country. This increased attention arose from the number of Anglo-Saxons who migrated at that time into Scotland, by whose endeavours the face of the country was shortly changed. During the twelfth and thirteenth centuries, the lowlands of Scotland were improved considerably, and their inhabitants were prosperous and happy. As a proof of their internal prosperity, it was in these centuries that all the religious houses were erected; and it is plain, that before any nation can be munificently pious, it must be flourishing and rich. In these periods the greatest part of our modern towns and villages were also built; and it was then that the people began to be civilized, and society to assume something of its present shape. Circumstances, however, soon occurred, which blasted, and in a manner destroyed, all these fair prospects; and Scotland, instead of advancing in prosperity, was

so completely wasted by civil broils and foreign wars, that the efforts of the people, during four succeeding centuries, were scarcely sufficient to restore matters to their former footing.

THESE civil broils originated in a contested succession to the crown, wherein the parties in the first instance were nearly matched; but afterwards, by the interference of Edward of England, the scale was turned, and, as generally happens in such cases, the country was brought under the dominion of a foreign invader. The death of Alexander III. in 1286, was the source of these evils. This event occasioned a contest concerning the succession between John Baliol and Robert Bruce, which, in the first instance, almost ruined Scotland, and ultimately brought destruction upon the followers of Baliol, and those who adhered to Edward of England, who claimed the sovereignty as lord paramount of the country. This contest, which lasted for many years, stopped the growing prosperity of the country, occasioned the towns and villages to be destroyed, turned the people's attention from internal improvement to resisting external attacks, and rendered them as barbarous and uncivilized as

they were before the days of Malcolm Canmore. The baneful consequences which flowed from a disputed succession, were hardly overcome, when England and Scotland were united under the government of one sovereign ; nor did they altogether disappear till the middle of the 18th century. Before that time the internal improvement of the country was neglected and overlooked, whilst the great bulk of the inhabitants continued in an abject and miserable state, imperfectly fed, destitute of other comforts, without the means of improvement, and altogether in a situation which can hardly be described at the present moment, when all these circumstances are completely reversed.

WITHOUT insisting upon these matters, it may be added, that the large armies brought into the field by the partizans of Baliol and Bruce, chiefly drawn from the low-country districts, furnish incontestible proof that the population of the country was at that time numerous. Now, as population and food must always go hand in hand, or, speaking more correctly, food must always precede population ; a sure evidence of agricultural prosperity at the end of the 13th century is thence furnished. Indeed, independent of abstract

reasoning, we have conclusive proof of the flourishing state of agriculture in Scotland at this period from other sources. According to Hemingford, a writer of no mean authority, it appears that the English army, when besieging the castle of Dirleton, in East Lothian, A. D. 1299, subsisted upon the peas and beans growing in the adjoining fields. Every agriculturist knows well, that these grains cannot be successfully cultivated, till husbandry has reached a pretty advance dstate; and therefore it is presumed, that the agriculture of the district alluded to was at that period very much improved. But another circumstance, concerning the prosperity of Scottish agriculture, still more decisive, may be gleaned from the wardrobe account of Edward I. ; wherein it appears, that when that monarch invaded Galloway in 1300, he purchased and exported from Kirkcudbright to Whitehaven, and other parts of Cumberland, greater quantities of wheat than perhaps the modern agriculture of that province could supply at the present day.

BUT the most precise and correct account of Scottish agriculture, during the Scoto-Saxon government, or from the reign of Edgar, who

mounted the throne in 1097, to the decease of Alexander III. 1286, may be found in Mr Chalmers's CALEDONIA, recently published, wherein the most diligent research is displayed, and every statement supported by respectable authorities. The authorities cited by Mr Chalmers are numerous and decisive. Without trusting to former writers, who rarely took the trouble to ascertain the truth of what they asserted, this gentleman sedulously consulted the ancient records, both of public bodies and private individuals, and has thereby thrown a light upon the ancient history of this country, sufficiently bright to illuminate the dark periods which he treated of, and inform the people of the present day concerning the former state of their native country, and the progress of agriculture and other useful arts.

ACCORDING to Mr Chalmers, agriculture, during the period of the Scoto-Saxon dynasty, was the universal object of pursuit, from the prince to the peasant. The king possessed manors in every shire, and managed and cultivated them by his thanes, or bailiffs. The nobles followed the king's example, and had many manors in their proper demesne. The bishops and abbots emu-

lated the nobles, in the extent of their possessions, and the greatness of their husbandry establishments ; and next to the kings, they may be considered as the greatest farmers of these times. Wool and skins were then the only articles of foreign traffic, the export commodities of Scotland, as happens with every country in a state of commercial infancy, being confined within a very limited sphere.

AT the period under consideration, the great body of cultivators were bondmen and *vileyns*, rather than freemen and farmers, not having any property of their own. But many free tenants were settled in the agricultural villages, who paid services to their lords ; as also many cottars, who, besides helping to cultivate the ground, followed some domestic trade, and yielded much assistance to their superiors. When the kings and barons, the bishops and abbots, began to emancipate *their men*, leases were first granted, not only of the land itself, but also of the stock employed in its cultivation. The stock, which thus accommodated both parties was called *Steelbow* ; in other words, it was a stock which was to be restored to the proprietor at a future

period, in the same value and condition as when it was leased. It is understood, that William the Lion, and Alexander II. made various regulations for promoting agriculture, and securing the rights of those employed in carrying it on ; but of these matters it is difficult to speak with precision. It has been asserted, with more confidence than knowledge, that Scotland was formerly wholly naked, and destitute of woods ; whereas there is every sort of proof, that nearly the whole of the country, in ancient times, was covered with timber trees. That the numerous mosses of Scotland were originally so many woods, is evident from the number of trees dug up in them, and from other circumstances handed down both by traditionary and written authority. The black and barren moors, which now disfigure the face of the country, were formerly clothed with woods, and furnished useful timber, and excellent pasturage. Oak appears, in those times, to have been the wood of most general use. The bridges, the castles, the churches, and the towns, were built with this sort of timber. The waste made in the course of different wars, added to the quantity used for domestic purposes, lessened the extent of wood-land ; and, as no steps were

taken to supply the vacancies which daily occurred, the whole, or nearly the whole, was, in the course of time, consumed and exhausted. There are, in the old maps of Scotland, many names of places derived from woods, of which the slightest trace or information cannot now be gained. In the chartularies, numerous notices of forests are given in counties where a single tree is hardly now to be seen.

THE lawless habits, which too generally prevailed during the Scoto-Saxon dynasty, made it necessary for the people to live in collected bodies; in villages and hamlets, rather than in farms, so that their mutual comfort and security might be preserved. To each of these villages was annexed a district of land, which was cultivated by husbandmen and their cottagers, in different proportions. The pasture-lands, and the wood-lands, were enjoyed in common; each of the villagers having a right of pasturage for a certain number of domestic animals, according to the extent of arable land possessed within the territory. These villages were of different sizes, according to the size of the estate upon which they were situated, and the fertility of the adjoining

lands. Some of them had a church, others a mill, all of them had malt-kilns, and brew-houses, as may be distinctly observed from a perusal of the ancient chartularies.

WHATEVER disadvantages attended the practice of agriculture in those days, husbandmen enjoyed many benefits, which farmers at this time cannot expect to possess. The vast wood-lands, which skirted the arable ground on all sides, gave a shelter to the corn crops, that greatly promoted their growth, and augmented their produce. While the wood-lands served to shelter the country, they also furnished pasturage for numerous herds of cattle, and of course rendered the condition of husbandmen comfortable and advantageous. In fact, the wood-land not only contributed to increase the produce of arable ground, but also to rear and maintain a larger number of swine, cattle, and horses, than will easily be believed under the prejudices of modern times.

SCOTLAND at that time produced all the kinds of grain cultivated in the present day, though, perhaps, in different proportions than those which are supplied by modern husbandry. Oats were

cultivated in a much greater, and barley in a much smaller proportion than at present. Oats were chiefly used by the lower orders, furnishing both meat and drink to them. Much of this grain was malted and afterwards brewed, as was also part of the barley. The consumption of ale was immense, as may be seen from the number of malting and brewing houses in every part of the country. Wheat was also cultivated to a great extent in all the south and east counties; even in Galloway, as already noticed, this grain appears to have been raised in considerable quantities. Pease and beans were only raised in particular situations. Besides corn, little else was produced in the fields. Lint, however, was certainly cultivated at the time we are treating of, because it is known to have paid tythe in the twelfth century. Though artificial grasses were not then introduced, yet the natural meadows and forests supplied much grass for making hay, as we learn from the chartularies.

IN the early ages of Scottish history, cheese was an article manufactured in great abundance; and, as the people lived much on animal food, the herds of black cattle were consumed at home,

while their hides formed a considerable article of export to foreign countries. Sheep were then numerous in every district, and wool and skins were great objects of agriculture revenue. Goats were also kept in many places, and swine were reared in great numbers by every husbandman, from the highest to the lowest. Poultry also was an object of attention.—Under Malcolm IV. the monks of Scone received from every plough-land which belonged to them, no fewer than *ten hens* at the feast of All Saints,—a burden which at this time would be considered by every husbandman as intolerably oppressive.

IN these early ages, the dwellings of the Scottish people were both mean and inconvenient. The kings, nobles, and bishops, dwelt in castles, built with a view to the protection of those who resided in them; while the lesser barons lived in square towers, constructed more for defence than comfort. The hovels of the lower ranks were generally slight erections of twigs or turf, and may be considered merely as temporary accommodations, seeing that they were so frequently laid waste and destroyed by foreign war and intestine divisions. Even houses in towns were

chiefly built with wood; hence followed the dreadful devastations in those periods. The cathedrals and abbeys, however, were structures of great labour and expence, as may be perceived on contemplating their ruins. The strongholds built in Scotland by the Anglo-Normans and Flemings, were so firmly cemented with lime, as to appear in many instances like solid rocks. Indeed it is often easier to dig stones in a quarry, than to procure them from these ancient buildings; hence many of them have been suffered to remain monuments of past greatness, which would have been demolished and taken down, had not the expence of the task exceeded the value of the materials which would have been acquired from their destruction.

THE towns gradually increased in their population and trade during the Scoto-Saxon period. A comparison betwixt their state and condition in the twelfth century on the one hand, and in the fifteenth on the other, will evince their gradual progress. In the twelfth century, the revenue drawn from the towns was inconsiderable; but during the fourteenth and fifteenth centuries, many annuities and pensions were

granted by the Scottish kings to their children and favourites, out of the mails of the burghs, and customs of their ports, both of which had greatly increased during these ages, notwithstanding that adversity and happiness alternately prevailed. The towns, however, even in the fifteenth century, were but hamlets compared with those of the present times, when industry has invigorated and enriched the inhabitants, and stimulated all ranks to provide more comfortable accommodation.

It may be remarked, that though the people, generally speaking, were but indifferently lodged, they were upon the whole well fed, except in those years of dearth and famine, which so often recurred in ancient times. In the thirteenth, fourteenth, and fifteenth centuries, the lower classes enjoyed a larger proportion of animal food than they do at present ; whilst their chief beverage was beer and ale, brewed from the malt of oats. In these times, cattle, sheep, swine, and poultry, were raised in abundance, and mostly consumed at home ; whereas in our day, from the increase of population, these articles are chiefly consumed in towns, modern prices exceeding the

means of purchase in the hands of the country labourer. The quantity of malt ground at the mills, and the number of breweries in every part of the country, attest the great quantities of ale made and consumed. None of the malt was manufactured into ardent spirits; but alehouses in the different villages were so early as the reign of David I. under the regulation of assize, which is an evidence, that their numbers were great, and that the consumption of ale was extensive in these primitive periods.

DURING the Scoto-Saxon period, the kings were the greatest improvers of land, and afforded every degree of encouragement to those who forwarded the rural improvement of the country. This is attested by the chartularies. The barons partially followed their example, but the monks were the most skilful and diligent improvers. Being mostly brought from England, and other countries, they possessed more knowledge of rural matters than the native inhabitants, and having greater capital, and enjoying more quiet, they were naturally better fitted and disposed for agricultural exertions. They brought waste lands into an arable state, subdued wood-lands, made

inclosures, and practised drainage,—improvements much wanted in the then state of the country. Possessing the teind, or tenth sheaf of the crop in many cases, the quantity of manure made on their lands was necessarily increased, and this increase of itself, independent of the knowledge and capital which they undoubtedly possessed, was sufficient to bring about a material change in the value of all lands, held by the regular and secular clergy of Scotland, at the period under consideration.

From what is stated, it may be inferred, that the rural economy of Scotland, at the end of the 13th century, was in a rapid state of improvement, especially in the low country districts to the south of the river Forth. It must, however, be remarked, that little of that improvement was owing to the Celtic natives, nearly the whole of it being attributable to those foreigners, introduced by the Scoto-Saxon kings. From the reign of Edgar to the conclusion of the Saxon dynasty, numerous bodies of Anglo-Saxons, Anglo-Normans, and Flemings, settled in Scotland, and, from the generosity of the several monarchs, acquired vast possessions in many districts. Edgar, the first of

the Saxon dynasty, forced his way to the throne by the decisive aid of an English army, and afterwards gradually brought in a new people, whose polity was widely different from that of the aboriginal inhabitants. Alexander I. who married an English princess, likewise encouraged settlers of that nation; but the reign of David I. was most propitious to adventurers from foreign countries. That prince, having married an English countess, who had numerous vassals, was attended to the throne, in 1124, by a thousand Anglo-Normans, to whom he distributed extensive landed possessions, and otherwise afforded them protection and encouragement.

NUMEROUS colonies of Flemings also settled in Scotland; and from this stock several of the first families of the country have sprung. The Celtic people had their hamlets, to which they gave descriptive names in their own language; but when the Anglo-Normans were introduced, their first object was to build a strong hold or castle, around which the followers of the chief settled, and thus formed a village, and in some cases a town; in which practice they were much encouraged by the several sovereigns, who wish-

ed to bridle and restrain the ferocity of the natives. The policy of the Scottish kings, during the Saxon dynasty, promoted the building of castles in every place where a convenient site occurred; and it was under the protection of these strong holds, that towns arose, and industry began her career. Such a system of policy, however, was viewed by the Aborigines with indignation. Insurrections were often raised, and attempts made to burn and destroy the towns that were erected, and to lay waste the lands which belonged to the inhabitants. After the capture of King William, in 1174, when anarchy prevailed for some time, the new settlers fled to the king's castles for shelter; and such had been the progress of colonization, that the towns and boroughs of Scotland were, at that period, chiefly inhabited by foreigners.

A POLICY of a different kind, but equally beneficial, contributed much to the improvement of the country. The erection of such a number of religious houses, in the twelfth century, was attended with salutary effects; because the monks were drawn from England and foreign countries; and of course brought along with them the arts

exercised in these countries, to the great benefit of the kingdom in which they now settled. These ecclesiastics had their dependants, to whom they granted parcels of land on the conditions of service; and it must be confessed, that the church lands were the first that were improved, and in such a substantial way, that many of them to this day continue to yield more productive crops than the lands then in the hands of the barons, though at first sight there may appear no difference in their natural value. The monks brought along with them many craftsmen or artisans from foreign countries; and in this way the settling of every religious house may be considered as the plantation of a new colony of the Teutonic race amidst the Celtic inhabitants of North Britain.

THE Succession War gave a shock to the prosperity of Scotland, from which it had not altogether recovered, at the time when the whole island was incorporated under one government. Were there the smallest doubt respecting the consequence of the wars, which, with short intermissions, prevailed from the end of the thirteenth to the middle of the fourteenth century,

it might be removed by a reference to the two valuations, called the Old and New Extent, in which full evidence is disclosed concerning the deterioration or waste which had taken place in North Britain. The old extent, taken in the reign of William the Lion, is nearly double the sum returned under the new extent made up in 1369, after the capture of David Bruce. But this difference of value will excite no surprise, when it is considered that the business of the inhabitants had been chiefly restricted to fighting and destroying one another, and to burning and plundering, instead of meliorating and enriching the country. The same conduct repeated in our day would lead to similar consequences; internal improvement being at all times incompatible with a state of warfare.

DURING the fifteenth and sixteenth centuries, rural economy continued to languish, especially upon the estates of the barons, where the profession of a soldier was regarded as of greater importance than that of a cultivator of the ground; but the ecclesiastical lands were considerably improved, and the tenants of them were generally much more comfortable and happy than those upon the

estates of laymen. The reformation of religion, beneficial as it was in other respects, rather checked than promoted agricultural improvement; because the change of property, which then occurred, occasioned a similar change of tenantry, and almost took husbandry out of the hands of the only class of people by whom it was practised upon correct principles. The dissolution of the monasteries and other religious houses, was also attended by injurious consequences in the first instance; though latterly the greatest benefit has been derived from tythes and church lands having come into the hands of laymen. It is probable, had not these circumstances occurred, that the tythe system would have still remained in force, and Scottish husbandry have continued under a burthen, which sinks and oppresses the cultivator of the sister country. But tythes having got into the hands of lay titulars, or impropriators, were in general collected or farmed with such severity as to occasion the most grievous complaints, not only from the tenantry, but also from the numerous class of proprietors, who had not been so fortunate as to procure a share of the general spoil. This, added to the desire shewn by the crown, to resume the grants made

when its power was comparatively feeble, occasioned the celebrated submission to Charles I. which ended in a settlement, that in modern times has proved highly beneficial, not only to the interest of proprietors, but likewise to the improvement of the nation. Tythes in fact are a burthen, which to all intents and purposes operate as a tax upon industry, though it was a long time before the beneficial consequences of withdrawing them were fully understood, or even discerned in this country.

THOUGH agriculture has unquestionably been benefited by the regulation of teinds or tythes, yet doubts may be entertained whether landed proprietors have reaped the full advantages which were intended by that regulation. They had, in the first place, to purchase the teind of their respective estates at nine years purchase of its then proven value, and, in the second place, are now subjected in every parish to a second payment, according to the present value, of all the teind that remains unexhausted or unappropriated. In this way proprietors have been, or may be, made to pay twice for their teinds, first, in the reign of Charles I. when they were purchased

from the Titulars, and again when annual payments are allocated to the clergyman or clergymen of the parish or parishes, where their property is situated. It is plain that this double payment could neither be the intention of his Majesty, when he pronounced the decret arbitral on the subject, nor of Parliament when they passed it into a law; and that the system, now adopted for appropriating unexhausted teinds, has arisen entirely from none of the commissions, appointed by parliament, having finally concluded and determined upon the whole matters committed to them. It may be objected that the price, nine years purchase of the then proven value, was fixed by Charles I. with a view of enabling proprietors to meet augmentations at an after period; but this objection will appear of no force, when it is considered that land at the time sold generally for ten, never above twelve years purchase; and that the interest of money was then eight per cent. Besides, Charles I. always declared that the teinds were fully paid for; and there is reason to presume that, had it not been for the disturbances which shortly followed, the business would have been completely settled according to the principles of his decret arbitral.

Had the original valuations remained in existence, proprietors, in general, would not have had great reason to complain of the recent decisions, seeing that the value of land has advanced so much; but when it is reflected that many of these valuations were either lost or destroyed when Cromwell removed the records of Scotland in 1652, or at the burning of the Teind Office in 1701, the subject becomes of more importance. No doubt every proprietor whose rights were thus destroyed, had he known how the law was to be afterwards interpreted, would instantly have forced a second valuation; but being in possession, and knowing that it was not the practice to insist for second augmentations under the same commission, probably the great body of land-holders thought themselves perfectly secure notwithstanding the want of their original valuations. The want of them is now, however, a serious loss to proprietors in possession. In fact, without a valuation, the fifth part of their property may be wrested from them; and as every man has a right to put what meaning he pleases upon the words 'expedient stipend,' there is no saying to what length the Court may go when making future augmentations. Were

Parliament to establish a *maximum*, people would know what they were about, and stipend, being paid in grain, the quantity which constituted an expedient stipend at one period, could not with justice be considered as inexpedient at another. Our wish is to see the clergy handsomely paid for their labours; but we do not wish to see them wrangling in law Courts about their temporal provision, lest that their usefulness may be afterwards lessened. It also deserves attention, that the salaries of schoolmasters, the building and repairing of churches, manses, and school-houses, and the support of the poor fall entirely upon the landed proprietors as possessors of teinds; of course those things ought to be held in view when teinds are appropriated for the benefit of those who occupy the Clerical Office.

The accession of James to the crown of England is understood to have been unfavourable to the agricultural interest of Scotland; inasmuch as the nobles and gentry being by that event led into great expenses, raised the rents of the tenantry considerably, whilst the very circumstance which occasioned the rise, contributed to lessen the means of the tenant for fulfilling his engage-

ments. Scotland, however, was much benefited by the soldiers of Cromwell, who were chiefly English yeomen, not only well acquainted with husbandry, but, like the Romans at a former period, studious also to improve and enlighten the nation which they had subdued. The soldiers of Cromwell's army were regularly paid at the rate of 8d. per day, a sum equal at least to the money value of two shillings of our currency; and as this army lay in Scotland for many years, there was a great circulation of money through the country. Perhaps the low country districts were at that time in a higher state of improvement than at any period since the demise of Alexander III. The improvement then introduced, does not altogether rest upon conjecture, but is supported by many facts. In the counties of Lanark, Renfrew, Ayr, and Kirkcudbright, the rentals of various estates were greater in 1660 than they were seventy years afterwards; and the causes which brought about a declension in value are ascertained without difficulty. The large fines exacted from country gentlemen and tenants in these counties, during the reigns of Charles II. and his brother James, were almost sufficient to impoverish both proprietors and cul-

tivators, had they even been as wealthy as they are at the present day. In addition to those fines, the dreadful imprisonments, and other oppressive measures pursued by those in power, equally contrary to sound policy and to justice and humanity, desolated large tracts, drove the oppressed gentry, and many of their wealthy tenants, into foreign countries, and extinguished the spirit of industry and improvement in the breasts of those who were left behind. A succession of bad seasons soon after the Revolution, heightened these calamities. It is well known, that innumerable farms at that period remained unoccupied ; proprietors having to search after tenants, who were able to stock and cultivate the ground with almost the same assiduity that must now be displayed by tenants who are out of possessions.

It would be unpardonable to omit noticing the active efforts of a Society, formed in 1793 for the improvement of agriculture, consisting of the principal noblemen and gentlemen of Scotland, who continued their labours for more than twenty years, greatly to their own credit and to the public benefit. Of this we have sufficient evidence from

a volume of their Transactions published in 1743, by Mr Maxwell of Arkland, under the auspices of the celebrated Mr Hope of Rankeillor, one of the most intelligent gentlemen of that period. The dedication to that volume shews something of the state of Scotland at that period, and proves that the endeavours of the numerous members of the Society were of immense benefit to the improvement of the country. In fact, the seed was at that time sown; and though the soil, in which it was deposited, was of a sterile nature, yet an abundant crop was in due time reaped.

THE most active and indefatigable member of that Society was Mr Hope of Rankeillor. This patriotic and well informed gentleman had, at an early period, studied agriculture, not only in England, but also in several foreign countries; and being enthusiastically fond of this primitive art, he lost no opportunity of communicating his knowledge, not only to his brethren of the Society, but also to every other person who took the trouble of soliciting information. It is well known that the meadow walks of Edinburgh were designed and laid out by this distinguished personage. The Meadows, originally a morass,

and called Straiton's Loch, were held by him upon a lease from the city of Edinburgh ; and upon them he executed improvements which excited the wonder and admiration of his contemporaries. At that period the situation of Edinburgh was very different from what it is at present. Bounded by the North Loch, then a sheet of water, and obstructed from all communication with the north, except by Leith Wynd and the West Church, the citizens could not take a walk, or breathe the fresh air, without being put to considerable inconvenience. Moved by these circumstances, Mr Hope projected the walks upon the south side of the city, and actually superintended their execution. These walks, at that time crowded by multitudes, are now in a manner deserted in favour of other places of public resort ; but this circumstance does not lessen the merits of Mr Hope's benevolent and patriotic endeavours to serve the public. In short, Mr Hope was one of those public spirited men who rarely appear. He was gifted by nature with a well informed mind, and constantly exerted himself to promote rural improvement, justly considering it as the true source of national prosperity.

THE endeavours of Mr Hope were warmly seconded by the Dukes of Hamilton and Athole, Lords Stair, Hopeton, Islay, and other members of the Edinburgh Society. Indeed the condition of Scotland at that time called for the utmost exertion of all its proprietors. Agriculture was in the most languid and feeble state. Occupiers of the ground were generally destitute of capital stock for carrying on improvements, and few of them were qualified for introducing these with success, even had the means been within their reach. Trades and manufactures were then in their infancy; and money was such a scarce article, that the circulating medium of the two Edinburgh banks, whose capital was below L.200,000, was quite sufficient for every useful purpose. Under these circumstances, the situation of Scottish agriculture, when this patriotic Society commenced their proceedings, may be easily ascertained. In short, rents were low, and the people were poor, imperfectly fed, badly clothed, and often without employment. If the picture is brought forward, and made to include the state of the country at the period we are now writing, it will at once be discerned, that a complete alteration has taken place in all these cir-

cumstances ; and though it would be going too far to place the whole alteration to the credit of the Edinburgh Society, yet a doubt cannot be entertained concerning the utility of their measures, or the effects which followed them.

BUT the merits of another individual, who was a member of the Edinburgh Society, must not be passed over on this occasion. That individual was John Cockburn, Esq. heritable proprietor of the lands of Ormiston, in the county of Haddington, who descended from a family known long as firm friends to the liberty of the subject, and always disposed to promote every measure which had for its object the improvement of the country.

JOHN COCKBURN, Esq. of Ormiston, was born in the year 1685, and was the eldest son of Adam Cockburn of Ormiston, Justice Clerk of Scotland during the reigns of King William and Queen Anne. Mr Cockburn, with the estate of Ormiston, inherited a large portion of genuine patriotism, and warmly supported the Hanoverian succession, considering that family as well disposed to promote constitutional freedom. Du-

ring his father's lifetime, he sat as a member of the last Scottish parliament, in which England and Scotland were united under one government, and took an active part in all the proceedings which happily terminated in connecting North and South Britain in the closest bond of union. Afterwards he was successively elected from 1707 to 1741 to represent the county of Haddington in the British Parliament; and for many years occupied the office of a Lord of the Admiralty, which, of course, occasioned him to reside much in England, and to become intimately acquainted with the rural practices of our southern neighbours. Though the low country districts of Scotland are at this day equally well improved and cultivated as any of the English counties, yet their state was very different at the period under consideration. Lord Kames, that excellent judge of mankind, and sound agriculturist, declares, in strong terms, that the tenantry of Scotland, at the end of the seventeenth and beginning of the eighteenth century, were so benumbed with oppression or poverty, that the most able instructor in husbandry would have made nothing of them. Fletcher of Salton, a contemporary of Mr Cockburn, describes their situation as

truly deplorable. In fact, many farms remained unoccupied ; even tenants rarely accepted of leases, at least they were shy, and unwilling to accept them for any considerable number of years ; hence improvement of every kind was totally neglected, and the general poverty of the tenantry necessarily occasioned landed property to be of little value ; because, while rents were trifling, they were also ill paid, which of course placed many proprietors in something like a state of mendicity.

At the begining of last century, the tenantry of Scotland, those of a few fertile spots excepted, were nearly ruined by the calamitous seasons which had previously occurred. Capital stock was thereby wrested from them, and proprietors, generally speaking, were still too proud, and perhaps too ignorant, to interest themselves about the amelioration of their own domains. The qualities supposed to compose the character of a feudal chieftain are badly calculated for promoting internal improvement ; and it may be remarked, that feudalism has been gradually undermined, in proportion as improvements have

been introduced. Such sentiments seem to have influenced Mr Cockburn; for all his words, all his actions, were dictated by a spirit which wished to increase the prosperity of the middling and lower ranks. In fact, the middling ranks are the strength and support of every nation. In former times, what we now call the middle classes of Society were not known, or at least little known, in this country; hence the feudal system reigned longer in Scotland than in England. After trade was introduced, and agriculture improved, the feudal system was necessarily overturned, and proprietors, like other men, were estimated according to their respective merits, without receiving support from the adventitious circumstances under which they were placed.

WHEN Mr Cockburn succeeded to the estate of Ormiston in 1714, the art of agriculture was so imperfectly understood, and the condition of the tenantry so reduced, that improvements could not be expected from them unless the strongest encouragement was previously held out. This was done by Mr Cockburn, even in his father's lifetime. As Robert Wight, one of the Ormiston tenants, had early shewn an uncommon spirit to

enter into Mr Cockburn's views, being probably the first farmer in Scotland who inclosed by ditch and hedge, and planted hedge row trees on his proper charge, he was singled out for favour; and in 1718 received a lease of the Murrays, or Muirhouse farm, of an uncommon long endurance. The lease was for 38 years, and the rent L. 750. Scottish money; but upon paying a fine or grassum of L. 1200 Scots, at the expiration of that term, a renewal of the lease was to be granted for 19 years more, and so on from 19 to 19 years in all time coming. The two subscribing witnesses to this deed were Sir John Inglis of Cramond, Bart. and John Hepburn, Esq. of Humbie, gentlemen invited on the occasion by Mr Cockburn, in order that his example might animate them with the like liberal and patriotic desire to improve the agriculture of their respective properties.

ALEXANDER WIGHT, eldest son of Robert above named, possessed the House of Muir farm by tacit relocation till 1725, at which period, agreeable to the plan adopted for encouraging substantial improvements, a lease was granted to him for 38 years, and three lives therein named.

This tenant, like his father, having entered warmly into Mr Cockburn's measures, got that lease cancelled in 1734, when a new one was granted for 19 years, renewable for every 19 years in all time coming, upon payment of a fine equal to one year's rent of the premises. These were leading examples to Scottish landlords, and held out to other tenants of the estate a noble encouragement to undertake improvements, seeing that their benevolent landlord was so ready to reward them.

IN this way the foundation of Scottish improvement was laid, by granting long leases. Many people at this time may think, that such a length of lease was unnecessary, and that the distinguished personage of whom we are speaking, might have accomplished his object, by granting leases of a more limited endurance. We would request such persons to reflect upon the state of the country, and the actual condition of the tenantry at the period under consideration. We ought not to judge of the propriety of measures then employed, to introduce and encourage improvement according to the rules of the present day, when tenants possess knowledge and capital

sufficient for carrying through the most difficult and arduous undertakings. Let it also be remembered, that both knowledge and capital were the undoubted result of the ameliorated system then introduced. Mr Cockburn laid the first stone of the system; his brethren in different quarters assisted in rearing the fabric, though perhaps their aid was not in any instance so munificent. The success which accompanied it, served however, to convince almost the whole landholders of Scotland, that the surest way of extending improvements was to give the tenantry an interest in their accomplishment. Hence the bond of connection betwixt proprietors and tenants in Scotland is formed upon more liberal principles than prevail in any other country with which we are acquainted. No man in Scotland, at least very few men, will enter to the possession of land unless the security of a lease is previously granted; and proprietors in general are so sensible of the benefit of that tenure, that few of them refuse to grant it for such a number of years as both parties may consider best adapted to the system of management meant to be exercised.

NOTWITHSTANDING that few improvements were introduced during the seventeenth century, several legislative enactments were then made, which latterly have produced much benefit to agriculture. Independent of the regulation of tythes, a measure of primary importance to husbandmen, the laws relative to the inclosing of land, and the division of mixed possessions, may be ranked as peculiarly calculated to excite improvement, in so far as the trouble of accomplishing these objects was greatly lessened, whilst precise rules were laid down, by which these improvements might be carried into effect. In these branches of rural legislation, Scottish practice holds out a judicious pattern for the imitation of our southern neighbours, who are confessedly behind in every one of them, and, in fact, cannot take a single step without the aid of the legislature. Want of capital stock was the greatest impediment to Scottish agriculture; but this was partly removed by the rebellion of 1745, when vast sums of money were poured into the country; and, since that period, the husbandry of Scotland has progressively improved, in such a manner as to bear comparison, local circumstances considered, with that of any coun-

try in Europe. Even the legal abrogation of the feudal system, by passing the Jurisdiction Act, was of material advantage, in so far as the security of cultivators was thus increased, and their situation rendered infinitely more independent than in former times. Since the conclusion of the American war in 1783, improvement has proceeded with singular rapidity in every district; and while the rental rolls of proprietors have been doubled, tripled, and quadrupled, the condition of the tenantry, and of the lower ranks, has been ameliorated almost in a proportional degree. These circumstances are sure tokens of agricultural prosperity, and demonstrate, in the most forcible terms, that husbandry is a main pillar of the state; and that the happiness and welfare of the community depends greatly upon the manner in which the art is executed. No nation, whose husbandry is feeble and imperfect, can be regarded as really prosperous, however considerable may be the advances made in other arts; because, when the art of raising food is neglected, all others must ultimately be forsaken. In short, to promote and encourage husbandry, to remove every obstacle that stands in the way of exercising it, and to secure those concerned in carrying

on the art, are duties obligatory upon the government of every country; and according as these duties are discharged, so will the wisdom of such a government be estimated by every man who feels for the prosperity of the state, or is attentive to the sources from which that prosperity proceeds.

HAVING thus given a concise history of agriculture, from such materials as were within our reach, we shall proceed to investigate the theory and practice of the art. Strictly speaking, the art of agriculture is confined to the cultivation of the earth, and does not include several other branches of work, which appertain to the general situation of husbandmen; but it may be proper to consider agriculture, in a more extensive sense, as embracing every subject connected with rural economy, or which serves to promote or impede agricultural improvement. To cultivate the soil, in a sufficient manner, is certainly a primary object with the agriculturist; but other objects equally claim his attention, as by neglecting them the primary object may be imperfectly obtained.

CHAP. I.

ON THE THEORY OF AGRICULTURE.

· THOUGH agriculture is an art which has been carried on from the earliest ages, by a greater number of people than are concerned in any other, yet, even at this advanced period, the agriculturist may, in some measure, be viewed as remaining without any fixed principles, for governing his mind and regulating his conduct. Instead of resorting to practice, and thence forming a satisfactory theory, writers on agriculture have, in numberless instances, amused themselves without instructing their readers, by presenting opinions purely speculative upon this important subject; not reflecting, that every kind of theory, which is not built upon extensive practice and

observation, is preposterous and absurd. According to the mode adopted by these gentlemen, he, who argues most ingeniously, must necessarily be received as coming nearest to the truth, and his doctrine be considered as the standard, till some competitor appears, whose eloquence is more persuasive, and whose opinions are more plausible. This has been the fate of all speculative opinions, since the earliest ages; and will continue to be so upon every subject, where no certain data can be found to direct the research of enquirers. For instance, how numerous and diversified are the sentiments of theorists concerning the food of plants; a subject not to be comprehended by the human mind in its present state, and upon which the wisest of men have done little more than display their presumption and their ignorance. It is a certain fact, that the most acute philosopher can no more account for the germination of a single grain of corn than he can explain the mysterious manner in which he enjoys rational existence. Without, therefore, stopping to enquire, whether fire, or air, or water, or earth, constitute the food of plants, or noticing the numberless hypotheses that have been presented on that abstruse topic, it

may be remarked, that the dullest farmer knows sufficiently, that if he cleans, and drains, and manures his land in a proper manner, it will yield him as good a crop as the soil is constitutionally capable of producing, provided physical circumstances, such as heavy rains, excessive droughts, furious winds, and similar evils, do not intervene and prevent nature from performing her usual functions. Allowing, however, for a moment, that we were able to ascertain, which of the above elements constitute the food of plants, the question *Cui bono?* still remains to be answered. As we have neither the command of fire, air, or water, nor can order the sun to display his beams, nor the air to blow genial gales, nor the clouds to drop refreshing showers, little benefit would accrue were even the curtain of nature withdrawn, and our eyes allowed to roam at large over a field, which may justly be considered as forbidden to man. Under these impressions, we are disposed to consider disquisitions, respecting the food of plants, and even concerning the principles of vegetation, as quite foreign to a treatise on agriculture. The operative farmer could not thereby be benefited in the smallest degree, nor would any part of his prac-

tice be illustrated or improved. Perhaps, on the contrary, he might be led out of the right path into the vortex of delusion, and induced to forsake that system of practice which is sanctioned by experience, and which ought to be his only guide in such disquisitions.

NOTWITHSTANDING that such are our sentiments on what has been erroneously called the theory of agriculture, yet we are inclined to believe a degree of certainty is already attained, concerning the real and efficient theory of the art, sufficient either to guide or to determine the conduct of those engaged in carrying it on. If the earth is enriched by generous manures, or stimulated by powerful cordials, as circumstances may require; if it is laid dry, or drained of superfluous water; if the soil is sufficiently cultivated, and its aboriginal inhabitants, namely *quickens*, and other weeds, removed; and if, in naked and exposed situations, shelter is afforded, by making inclosures, then every thing that man is capable of doing to forward the productive powers of the earth, is completely executed. Here the true theory of agriculture is to be found; and a due knowledge of these principles, carried properly.

into execution, distinguishes the good farmer from the bad. In short, the man who is governed by these principles, may be considered as possessing more knowledge of the art, than the most scientific agriculturist. The one acts upon principles which never can fail, and which uniformly lead to the same issue; the other is guided by no certain principle whatever, but is led by an *ignis fatuus*, whose delusions may draw him into bogs and quagmires, where he may flounder for a while, and at last be ruined and made miserable, both in fortune and reputation.

THE theory of agriculture, which we lay down, is therefore built upon the following fundamental principles; and with one or other of them every part of rural practice is more or less connected:—*First*, That the soil ought to be kept dry; or, in other words, free from all superfluous moisture. *Secondly*, That it ought to be kept clean; or, in other words, free from noxious weeds. *Thirdly*, That it ought to be kept rich; or, in other words, that every particle of manure, which can be collected, ought to be applied, so that the soil may be kept in a state capable of yielding good crops. Every person, possessed of a sufficient capital stock, may act according to

the first and second principles; but it is only where local circumstances are favourable, that the last can be carried completely into effect. No more, however being required of the farmer, than that he shall make the most of his situation, the principle applies equally to all; and, in like manner, is equally correct and beneficial in all situations and circumstances.

HOLDING these principles in view, and assuming them as the basis of what is meant to be inculcated, we proceed to illustrate them in a more particular manner.

IN the first place, the utility, nay, the necessity of keeping land dry, and preserving it from being inundated or flooded with water, is so obvious, that few arguments will be required in support of this primary principle. When land is allowed to remain in a state of wetness, which may either be occasioned by spouts, or springs, in the under soil, or by rain-water stagnating on the surface, the earth gets into a sour state, which is afterwards detrimental to the growth of plants; and often, in the first instance, prevents either ploughing or harrowing from being successfully

effected. Under such circumstances, the young plants, either of corn or grass, get yellow and sickly, and never assume that vigorous thriving aspect, which they maintain upon fields differently circumstanced. Besides, manure has not the same effect when the soil is drowned, or even injured with wetness, as when it is kept dry and free from superfluous moisture. Under-draining is the only method of correcting the evils arising from spouts, or springs, as will afterwards be more distinctly stated, and digging out the head-land, and what are provincially called *gau-furrows*, the only preventive against surface-water, when heavy falls of rain or snow-storms ensue. In fact, without attention to these important operations, arable land can neither be perfectly managed, nor full crops reaped. Perhaps, the goodness or badness of farm-management may be as correctly estimated by the attention shewn to drainage, as by any other mark whatever. Where drainage is neglected, a sure proof is furnished that many other branches of the art are imperfectly executed. Unless, therefore, this branch of rural economy is assiduously attended to, the advantages arising from ploughing and manuring are only partially obtained.

IN the second place, the benefit arising from keeping the land clean is sufficiently discernible. Weeds, whether annual or perennial, may be regarded as preferable creditors of the soil, who will reap the first advantage of manure, if allowed to remain in possession; their removal, therefore, forms an important object of the husbandman's attention. Without detailing, in this place, the most suitable means of removing them, it may be stated, that, according to the degree of success that follows the means employed, so will the goodness or badness of the husbandman's crop be regulated. If the strength or nutritive powers of the soil be exhausted or drawn forth by weeds, or such plants as the soil naturally produces, it is impossible that artificial plants can prosper. It rarely happens, to be sure, that the aborigines are altogether extirpated; but upon the smallness of their number depends the return which the soil can make to man, for the labour bestowed upon its cultivation.

IN the third place, the necessity of restoring to the soil, in the shape of manure, the powers drawn from it by artificial crops, is acknowledged almost by every person. No doubt, some here-

tical opinions have, at different times, been broached, concerning the utility of feeding land by generous manures; but these never had many votaries, and are now become so obsolete, that it would only be a waste of time to notice them. Manure, in fact, is the most powerful agent in the hands of the farmer; and the attention bestowed upon collecting, preparing, and applying it, constitutes an important branch of the art which he practises. Perhaps agriculturists are more behind, in the points connected with this third general principle than in the others; and here the utility of chemical knowledge may, in some respects, be estimated and recognised.

THESE three fundamental principles stand or fall together. Without laying land dry, neither the advantages of good ploughing, nor the benefits arising from manure, can be fully obtained. When any of the other principles are neglected, similar defects will necessarily ensue. But when they are all acted upon; when the land is kept dry, clean, and in good heart, the husbandman may expect a suitable reward for the trouble and expence bestowed on its cultivation. An agricultural code of this kind is not only a true one,

but has the particular merit of being simple and distinct; nay, it has an advantage which few creeds possess; it may be understood by the dull-est capacity. Were it carried into execution, were the operations of farmers regulated by its tenets, were their endeavours constantly directed to keep the lands in their possession dry and clean, and as rich as possible, then the country would be progressively improved. In a word, these are the fundamental principles of agriculture, though several other things, such as rotations of crops and the like, may be regarded as minor or inferior objects. All of them, however, are dependent upon the principles already noticed; because, were the fundamental principles neglected, the minor or dependent ones could never be successfully carried into execution.

CHAP. II.

ON SOILS.

SECT. I.

SOIL, strictly speaking, is the ground or earth wherein crops of every kind are produced ; and we notice it in this way, merely to distinguish the surface from the under stratum or subsoil on which the surface is incumbent. The value or worth of that part of the earth, which is the object of cultivation, depends materially upon the nature of the under stratum ; because, when the latter is close or extremely retentive of moisture, the expence and hazard of cultivating the surface is considerably increased, whilst the growth of plants cultivated upon it is much abridged and impeded, particularly in adverse seasons.

THE nomenclature of agriculturists, with regard to soils, being variable and indistinct, it is a

difficult task to describe them, or to mark with any degree of accuracy the shades which distinguish one from another, so nearly are many of them connected. Generally speaking, the component parts of soil, whatever may be the colour, are argill, sand, water, and air ; for into these original principles may all earths be reduced, however blended with apparently foreign substances. Argill is the soft and unctuous part of clay. The primitive earths, argill and sand, contain each, perhaps in nearly equal degrees, the food of plants ; but in their union the purposes of vegetation are most completely answered. The precise quantities of each necessary to make this union perfect, and whether they ought to be equal, it is not very easy nor very material to ascertain, since that point is best determined in practice, when the soil proves to be neither too stiff or adhesive, from the superabundance of clay, nor of too loose and weak a texture, from an over quantity of sand in its composition. The medium is undoubtedly best ; but an excess towards adhesion is obviously most safe. A stiff or strong soil holds the water which falls upon it for a long time, and being capable of much ploughing, is naturally well qualified for carrying

the most valuable arable crops. A light soil, or one of a texture feeble and easily broken, is, on the contrary, soon exhausted by aration, and requires renovation by grass ; otherwise it cannot be cultivated to advantage.

DR W. DICKSON, in his excellent treatise on agriculture, says, with much truth, that the soils of this country have been described under numerous heads, and particularised by an useless variety of vague local terms. According to him, however, they may be considered and characterised, as far at least as is necessary for practical purposes, under the distinctions of Clayey, Loamy, Chalky, Sandy, Gravelly, and Peaty, or Mossy. Each of these diversities, of course, comprehends several varieties, according to the nature and preponderance of the different sorts of materials of which they are composed.

OTHER writers speak of a soil which they call *garden mould* ; but this, being entirely of artificial creation, ought not to be ranked amongst the natural or original soils.

IN a work of this kind, it may be proper to arrange British soils into four different classes, namely clay, sand, gravel, and peat earth; as to one or other of these classes each of the numerous varieties in the British isles is allied, though in many cases the degree of affinity is not easily ascertained. Loam has generally been considered as an original earth, though we are disposed to view it as an artificial soil, produced by calcareous matters, and animal and vegetable manures. The strongest clay may, in process of time, be converted into a loam, by repeated applications of these substances; and the richness or freeness of that loam will depend entirely upon the quantity of manure with which it has been supplied. Sandy soils may also be converted into light loams, by the application of lime, chalk, marl, and especially clay. Even peat may be converted into a black soft loam, and in various ways rendered fertile and productive. From these circumstances, a degree of confusion prevails respecting the nature and properties of soils, which renders the subject more difficult than at first sight might be expected. Even the admixture of surface and subsoil, by deep ploughing, creates a change of considerable magnitude.

A CLAY soil, though distinguished by the colour which it bears, namely black, white, yellow, and red, differs from all other soils, being tough, wet, and cold, and consequently requiring a good deal of labour from the husbandman before it can be sufficiently pulverised, or placed in a fit state for bearing artificial crops of corn or grass. Clay land is known by these qualities or properties. It holds water like a cup, and once wetted does not soon dry. In like manner, when thoroughly dry, it is not soon wetted; if we except the varieties which have a thin surface, and are the worst of all to manage. In a dry summer, clay cracks, and shews a surface full of small chinks, or openings. If ploughed in a wet state, it sticks to the plough like mortar; and, in a dry summer, the plough turns it up in great clods, scarcely to be broken or separated by the heaviest roller.

SANDY soils next come under consideration. Soils of this description are managed with infinitely less trouble, and at an expence greatly inferior to what clays require; but, at the same time, the crops produced from them are generally of smaller value. There are many varieties of

sand, however, as well as of clay; and in some parts of the island, the surface is little better than a bare barren sand, wherein artificial plants will not take root, unless a dose of clay or good earth is previously administered. This is not the soil meant by the farmer when he speaks of sands. To speak practically, the soil meant is one where sand is predominant, although there be several other earths in the mixture. From containing a great quantity of sand, these soils are all loose and crumbling, and never get into a clod, even in the driest weather. This is the great article of distinction betwixt sands and sandy loams. A sandy loam, owing to the clay that is in it, does not crumble down, or become loose like a real sand, but retains a degree of adhesion after wetness or drought, notwithstanding of the quantity of sand that is mixed with it. Perhaps a true sandy loam, incumbent upon a sound subsoil, is the most valuable of all soils. Upon such, every kind of grain may be raised with advantage, and no soil is better calculated for turnips and grass.

THE real sands are not favourable to the growth of wheat, unless when preceded by clover, which binds the surface, and confers a tem-

porary strength for sustaining that grain. Much of the county of Norfolk is of this description; and it is well known that few districts of the kingdom yield a greater quantity of produce. Till Norfolk, however, was invigorated by clay and marl, nearly one half of it was little better than waste; but, by the success which accompanied the use of these auxiliaries, a new soil was in a manner created; which, by a continuation of judicious management, has given a degree of fame to the husbandry of that county, far surpassing that of other districts naturally more fertile.

WE have now to speak of gravelly soils. The open porous nature of these soils disposes them to imbibe moisture, and to part with it with great facility; from the latter of which circumstances they are subject to burn, as it is termed, in dry seasons. The main difference between gravel and sand is this, that the former is chiefly composed of small soft stones; though, in some instances, the stones are of the silicious or flinty nature, and in others of the calcareous and chalky. From these constitutional circumstances arises the propriety of deepening gravelly soils by

coats of marl or earth, and of keeping them fresh by frequent returns of grass, and repeated applications of manure. Gravelly soils, from the lightness of their texture, are not expensive or difficult in the means of cultivation. All the necessary business required for gravels may be carried forward with ease and expedition; and such soils are, in general, soon brought into a proper state for the reception of crops.

FROM what is said respecting gravels, it will appear, that naturally they are barren, unless when mixed with other earths; and that the surface of most of them would exhibit the same appearance as the subsoil, or what is beyond the reach of the plough, were it not changed and meliorated by vegetable matters. The constitutional qualities of gravels also point out the propriety of ploughing them deep, so that the surface soil may be augmented, and greater room given to the growth of the plants cultivated on them. A shallow-ploughed gravel can stand no excess of weather, however enriched by manure. It is burnt up by a day or two of drought, and it is almost equally injured by an excessive fall of rain, unless the pan or firm bottom, which such soils

easily gain, be frequently broken through by deep ploughing. According to an old adage, the top of clay, and bottom of gravel, are best ; but though we cannot subscribe to the first part of the adage, being satisfied that deep ploughing is highly beneficial, except where the subsoil is of a poisonous nature, we are certain that the latter is well founded, and ought never to be overlooked.

PEAT earth, or moss, is the next kind of soil which we have to treat of ; though we are uncertain whether, like loam and garden mould, it ought not to be viewed as an artificial soil, made and produced by certain substances deposited on the surface of the earth, and not one originally created, or to be found in the early ages. On these points philosophers are much at variance ; and the discordant opinions entertained by them, induce us to think, that very little real knowledge of the nature and properties of moss has hitherto been acquired. By one we are told that peat is a primitive earth, of antediluvian origin ; by another, that it is a vegetable, which grows and increases, and may continue to increase, till it swallows up and destroys all other soils ; by another,

that it consists of ligneous and aquatic plants, brought into action by the destruction of extensive forests, which abounded in Europe in former times ; these forests having been either destroyed by the Romans, or by tempests, or having fallen into decay from natural causes. We are much inclined to adopt this last hypothesis, as it seems supported by the appearance which peat moss presents ; by facts which may be gathered from the history of Britain ; and, in particular, by the state and condition of the very places where peat moss is now the predominant soil. It is truly wonderful that so little is known on a subject of so much importance, not only to the prosperity of Britain, but even to that of the world ; and, on these accounts, our observations shall be extended to a greater length than at first sight may seem to be necessary.

THE natural history of peat moss is one of the most interesting and important branches of science. Whether we consider the vast extent of surface covered with that substance, or the economical purposes to which it has been, or may be, converted, the subject must rise high in the estimation of every enlightened mind.

IT seems strange to us that geologists and natural historians have paid so little attention to the origin and qualities of that substance. Among all the variety of opinions and theories that have been suggested, it is truly surprising that, in an age of science and enlightened enquiry, there should be such a discordance; and it is still more surprising, that in no age nor language have we heard of or seen a scientific or satisfactory account of the subject. To state the vast variety of hypothesis that have been formed; or to elucidate the subject ourselves, is not our province. We are happy, however, to learn that some gentlemen have of late turned their attention to it; and we flatter ourselves that the attention of the public, and especially of scientific men, will thereby be arrested, and their talents called forth and turned to this subject, hitherto much neglected and little known. If those authors succeed thus far, they must do an essential service to their country. Even though they should fail in fully elucidating all the branches of such an extended enquiry, the very attempt to do so claims the gratitude of the public.

THE Rev. Dr Rennie, Kilsyth, one of our friends, and for whose sentiments we entertain great respect, has already thrown some light on the subject; and we are happy to learn that he is still engaged in these researches. We have seen the outlines of the whole work which he proposes to publish. We have likewise perused his two first essays; and as we are persuaded that he gives a most ample detail of facts in illustration of the hypothesis he has adopted, we cannot but recommend these essays to the attention of the public.

WITHOUT adopting that hypothesis ourselves, or pledging ourselves for the correctness of it, we cannot refrain from giving a short glance at the outlines he has filled up with such labour and so much research. The general jet of his theory is, that ligneous and aquatic plants have furnished the materials of all the mosses in the world.

HIS first essay is entirely devoted to the former, and the second to the latter. The amount of the first essay is, that forests abounded in the north of Europe 2000 years ago; that these forests have fallen into decay at different periods, and by different means; that the detritus or ruins

of these forests, namely, the leaves, seeds, twigs, bark, rind, roots, and trunks, of the immense trees which abounded in them, have laid the foundation of, and furnished materials for, the formation of most mosses in Europe ; and that according to his calculations, these materials are sufficient. To establish this point, he proceeds to obviate the various objections that have been made to this hypothesis. In doing so, he displays considerable acquaintance with geology in general, and still more with the natural history of peat moss in particular.

To give a detailed account of the facts he brings forward, or to follow him through all his variety of argument would be utterly inconsistent with our general plan. To appreciate these the reader must consult the essays for himself.

The second essay appears to us still more satisfactory ; and seems to be altogether an original work ; at least, we have perused no author who has exhibited the subject in this point of view. The following statement may serve as a short glance of the general plan of this part of the work. He begins, by shewing that moss is of-

ten renovated when dug; and, in certain circumstances, with great rapidity;---points out what is requisite for this purpose;---the period of time required;---and the plants that tend to promote this process. From the facts which he adduces in corroboration of these points, he concludes, and attempts to prove that the same plants have contributed to the original formation and subsequent increase of peat moss;---that by these many lakes have been filled up and converted into mosses; and, as a proof of this, that these plants may be traced in a distinct organised form at all depths. And he very properly introduces a section, in which he points out the distinguishing qualities of these aquatic plants.

UPON a general survey of the subject, he draws the following conclusion,---that all moss is of vegetable origin, and that it consists of a congeries of ligneous or aquatic plants, or of both; that the surface on which moss now lies has undergone a variety of changes during the lapse of time;---that moss rapidly increases in some situations; and that the deepest mosses in the world may not be of very ancient origin.

TAKING it for granted that peat moss is a congeries of vegetable matter, it will, on this supposition, be reasonable to conclude, that this vegetable matter has undergone certain chemical changes, and that it must differ essentially from the recent vegetables of which it is composed. What these precise changes are we pretend not to say. This is the province of the chemist and natural historian ;---and we trust and hope that the essays of Dr Rennie will elucidate the subject.

IT appears to us, however, that moisture or stagnant water is absolutely necessary to accomplish these changes. It appears, likewise, requisite that the water should be of a low temperature, and possessed of certain chemical qualities, distinct from rain or river water. For, if a mass of vegetable matter were kept dry, or even exposed to a current of water, it would not be converted into moss but vegetable mould ; or, if this water were of a high temperature, or exposed to any great alternations of heat and cold, in this case also no moss could be formed. In short, we are of opinion that the same circumstances are requisite to the formation of moss as Dr

Rennie, in his second essay, states to be necessary for the renovation of that substance. Upon the whole, it appears to us certain, that moss is composed of the same original materials with the richest vegetable mould ; and that the difference which subsists between these two substances, depends entirely upon the medium in which these materials have been immersed. The same vegetables which are converted into mould, in the medium of the atmosphere, would have undergone different changes when immersed in water of the above qualities ; in other words, they would have been converted into moss.

To point out the chemical agents which operate in each of these media, and the changes thereby produced, and to describe the precise process of nature by which moss is formed, might be a curious, useful, and important task ; and probably till this is accomplished, we will still grope in the dark as to the natural history of that most singular substance. On this subject, however, we do not enter.

It may be of more importance to ascertain and describe the peculiar qualities of peat moss,

which distinguish it from vegetable mould, supposing them to be formed of similar materials. This subject is much less intricate ; and to most of our readers may appear to be of more general importance.

It is obvious, at first sight, that inflammability forms one of these distinguishing qualities. That a piece of moss, of the same dimensions and in the same state of dryness is much more inflammatory than a similar piece of mould cannot be doubted. That some mosses are highly inflammable cannot be denied ; and it is asserted by some writers that others are so very inflammable as to catch fire by lightning, or even of their *own accord*, and burn with irresistible fury.

THIS quality, and especially the very high degree of it, is deemed by some unaccountable and inconsistent with the hypothesis, that all moss is of vegetable origin. To suppose that a branch of a tree, or any other vegetable, should possess a greater degree of inflammability than in their recent state, and that too by being immersed in water for ages, appears to some an hypothesis so

supereminently extravagant, that it needs only to be pointed out to be reprobated.

It is the province of the natural historian to obviate this objection and account for this seeming inconsistency. It belongs to us only to mention the fact, that of all vegetable matter moss is the most inflammable.

THE antiseptic quality of that substance deserves likewise to be noticed. That vegetable and animal matter is preserved in moss in an entire organised state for ages, without undergoing the putrid fermentation, is so well attested that we cannot possibly doubt of the fact. We have heard of innumerable instances of the bones and even fleshy parts of animals being found in this state, and cannot but consider this as a singular quality in peat moss; for the same substances immersed at an equal depth in vegetable mould, for a *much shorter period*, uniformly undergo putrefaction, and become so blended with the soil that, excepting the bones and harder parts, they can scarcely be distinguished from the surrounding mass in which they lie.

IT might be a curious, and even useful, subject of investigation to ascertain the causes of this distinguishing quality. As far as we know, this has never hitherto been attempted. Perhaps it might throw much light both on the natural history of that substance, and on the mode of converting it into a soil or manure, or other economical purposes. It would, however, require a distinct chemical treatise on the subject to elucidate this point. This we do not profess to offer, though we cannot dismiss the subject without recommending it to the particular attention of those who profess to treat of moss.

As to the colour of peat moss, it is somewhat peculiar; but whether it can be considered as a distinguishing quality, we do not pretend to say. Suffice it only to observe, that the colour of all moss water is not only nearly *the same*, but it differs from vegetable mould considerably, and more especially in this one respect, that it communicates its own colour to vegetable matter immersed in it much more readily than vegetable mould: To ascertain the causes of this, and of the varied tinge of different mosses, in all their gradations from a fairer colour to that of a jet black,

is not our object. It might, however, be of essential consequence to the public, more especially as it is well known that, in certain cases, moss waters have been used with great economy for *dyeing different colours*, on all varieties of matter, such as linen, woollen, wood, and ivory. If this be well attested, and if the causes could be ascertained on clear chemical principles, means might be devised for converting that substance to an important commercial purpose.

THE tenacity of peat moss is another distinguishing quality which claims our attention. When peat is newly dug it is a soft *plastic mass*, and partly soluble in water; but, when dried, it becomes a hard elastic substance, almost utterly insoluble in water, which is not the case with vegetable mould. It may be difficult to account for this; but it is of essential importance, whether moss be considered as a soil or a manure. Its sterility or fertility, in either case, may probably depend much on this very circumstance. At all events, its insolubility in water, when thus dried, ought to be accounted for, and the causes of it clearly explained; for we hesitate not to say

that, while it continues in this state, it cannot operate either as a soil or a manure.

ACIDITY is another quality of all peat. It cannot indeed be said to be a distinguishing one; for many stiff clays, which are vulgarly, though very properly, called sour lands, are possessed of the same. It is not the case, however, with all clay lands; whereas every moss, and of every species, discovers this, either on distillation, or by the application of chemical tests. How to account for this we do not pretend to say; but, in as far as moss may be considered as capable of being converted either into a soil or manure, it is certainly of the last importance to ascertain this fact, and the *causes of it*.

THERE is another quality which distinguishes moss and moss water from other soils or substances that seem to be homogeneous in their origin. While insects of all kinds and worms, &c. exist or abound in vegetable mould near the surface; and while all kinds of fishes abound in running or stagnant water in every other case, neither the one nor the other can be traced in moss, or stagnant moss water, unless there is a copious

supply of fresh running or spring water. This is one of the most curious and interesting qualities of that substance. It would require the talents of an accurate chemist or natural historian to detect the causes of this distinguishing quality. In all likelihood this might throw much light on the last, and by far the most important quality of peat moss, which distinguishes it *most essentially* from vegetable mould ; we mean,

Its sterility in its natural state. While vegetable mould forms the richest of all soils, and furnishes even a manure for other soils, moss, in its natural state, may be said to be the most barren of all. If it were possible to ascertain with certainty the causes of this distinction, it would be one of the most important discoveries that science itself has made ; and the man who does so would deserve well of his country ; for if once the disease was ascertained, and the causes of it clearly pointed out, the remedy might be found and applied with absolute certainty of success. Hitherto the attempt has scarcely been made ; and we have but faint hopes of success in the arduous and important undertaking. Without such a discovery, however, all attempts to

convert moss into a soil or manure must at best be hazardous and uncertain. We may stumble by accident on the proper remedy ; but accidental discoveries, without knowing the principles on which they proceed, must be unsatisfactory at best. It appears to us demonstrable that different mosses require different treatment, and that no one general mode of improving them can apply to all.

SECT. II.

On the Uses to which each Soil may be most advantageously applied.

CLAY soils, when sufficiently enriched with manure, are naturally well qualified for carrying crops of wheat, oats, beans, and clover ; but are not fitted for barley, turnips, potatoes, &c. or even for being kept under grass longer than one year. Perhaps such soils ought to be regularly summer-fallowed once in six, or at the most once in eight years, even when they are comparatively in a clean state, as they contract a sourness and adhesion from wet ploughing, only to be re-

moved by exposure to the sun and wind during the months of summer. Soils of this kind receive little benefit from winter ploughing, unless so far as their surface is thereby presented to the frost, which mellows and reduces them in a manner infinitely superior to what could be accomplished by all the operations of man. Still they are not cleaned or made free of weeds by winter ploughing; therefore this operation can only be considered as a good mean for procuring a seed-bed, in which the seeds of the future crop may be safely deposited. Hence the necessity of cleaning clay soils during the summer months, and of having always a part of every clay farm under summer fallow. All clay soils require great industry and care, as well as a considerable portion of knowledge and experience in the mode of managing and dressing them, so as they may be kept in good condition; yet when their natural toughness is got the better of, they always yield the heaviest and most abundant crops. One thing requisite for a clay soil, is to keep it rich and full of manure; a poor clay being the most ungrateful of all soils, and hardly capable of repaying the expence of labour, when worn out and exhausted. A clay soil also receives, comparatively, small be-

nefit from grass ; and, when allowed to get into a sterile condition, the most active endeavours of the husbandman will be required to restore it to fertility.

UPON light soils the case is very different. These flourish under the grass husbandry ; and bare summer fallow is rarely required, because they may be cleaned and cropped in the same year, with that valuable esculent, turnip. Upon light soils, however, wheat can seldom be extensively cultivated ; nor can a crop be obtained of equal value, either in respect of quantity or quality, as on clay and loams. The best method of procuring wheats on light lands, is to sow upon a clover stubble, when the soil has got an artificial solidity of body, and is thereby rendered capable of sustaining this grain till it arrives at maturity. The same observation applies to soils of a gravelly nature ; and upon both, barley is generally found of as great benefit as wheat. The facility with which every variety of light soil may be cultivated, furnishes great encouragement to keep such under the plough, though it rarely happens, that when more than one-half of them

is kept under aration, the possessors are greatly benefited.

THIN clays, and peat earths, are more friendly to the growth of oats than of other grains, though in favourable seasons a heavy crop of wheat may be obtained from a thin clay soil, when it has been completely summer-fallowed, and enriched with dung. A first application of calcareous manure is generally accompanied with great advantage upon these soils; but when once the effect of this application is over, it can hardly be repeated a second time with advantage, unless the land has been very cautiously managed after the first dressing. Neither of these soils are friendly to grass, yet there is a necessity of exercising this husbandry with them, because without it they are incapable of standing the plough more than a year or two in the course of a rotation. When we come to that branch of our work which treats of cropping, we shall notice these matters at greater length; but in this place it may be sufficient to say, that wheat ought to be the predominant crop upon all the rich clays and strong loams, and that light soils of every kind are best qualified for turnips, barley, &c.

Upon thin and moorish soils, oats must necessarily preserve a prominent rank ; and grass seeds may be cultivated upon every one of them, though with different degrees of advantage, according to the natural and artificial richness of each soil, or to the qualities which it possesses for encouraging the growth of clover, in the first instance, and preserving the roots of the plant afterwards.

THOUGH many mosses are of small value, yet some of them, particularly those incumbent upon clay and alluvial subsoils, when the surface is removed, may be cultivated with the greatest advantage. The Kincardine moss, between the rivers Forth and Teeth, in Perthshire, mostly belonging to Mr HOME DRUMMOND of Blair Drummond, is the most striking instance within our knowledge of the great improvement that may be made by a removal of moss land, which in this instance was fully seven feet deep upon an average. It is presumed that this immense field of moss was produced by cutting down the trees which occupied the ground in former times ; and as these trees had not been carried off, it is not difficult to account for the several processes

which afterwards took place before the moss was completely formed.

THE moss is composed of different vegetables arranged in three distinct strata. Of these the first is three feet thick. It is black and heavy, preferable to the others for the purpose of fuel, and 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. It is composed of various kinds of mosses, but principally of bog moss (*sphagnum*). It is of a sallow or iron colour, and remarkably elastic. It is commonly called white peat, and for fuel is considered as much inferior to that above mentioned. The third stratum is composed of heath and a little bent grass, but chiefly of the deciduous parts of the former. It is about a foot thick, and black.

THREE strata of different vegetables lying above each other, the limits of each distinctly marked, and each distinguished by a different colour, is certainly a curious natural phenomenon.

AN inquiry will here occur, what has occasioned this succession in the vegetables of which the moss is composed ?

EVERY vegetable has a particular soil, more or less moist, peculiarly adapted to its nature. Let a piece of ground be in a moist state, rushes will 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 that compose 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, it is evident, would produce a great stagnation of water, which, as the crops of bent grass accumulated would still increase : 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. But it is evident that a plant was to be found that could live in such a situation. Accordingly we see that bog moss had established itself ; a plant that loves even to swim in water.

WHEN the accumulation of bent grass and the mosses had, in process of time, arisen to the height of 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 immediate surface being wholly turned into little hillocks, has become dry and firm. By this means it became unfit for mosses, and heath succeeded.

SUCH seems to have been the process of what is now called a moss,

IN the year 1766, Lord KAMES entered into possession of the estate of Blair Drummond. Long before that period he was well acquainted with the moss, and often lamented that no attempt had ever been made to turn it to advantage. Many different plans were now proposed; at length it was resolved to attempt, by means of water, as the most powerful agent, entirely to sweep off the whole body of moss.

THAT moss might be floated in water was abundantly obvious; but to find water in suffi-

cient quantity was difficult, the only stream at hand being employed to turn a corn mill. Convinced of the superior importance of dedicating this stream to the purpose of floating off the moss, Lord Kames having made an agreement with the tenant who farmed the mill, and the tenants thirled consenting to pay the rent, he immediately threw down the mill, and applied the water to the above purpose.

IN order to determine the best manner of conducting the operation, workmen were now employed for a considerable time upon the low moss, both by the day and by the piece, to ascertain the expence for which a given quantity of moss could be removed. It was then agreed to operate at a certain rate per acre ; and in this manner several acres were removed.

BUT this was found to be a very expensive process. The ground gained might, indeed, be afterwards let to the tenants; but every acre would require an expenditure from L. 12 to L. 15 before it could be ready for sowing ; so that the acquisition of the whole, computing it at a medium to

be 1350 acres, would sink a capital of nearly L.20,000 Sterling.

ONE other method still remained, namely, to attempt letting portions of the moss as it lay for a term of years sufficient to indemnify tenants for the expences incurred in removing it. For some time both these plans were adopted ; but several reasons made the latter preferable. 1. The quantity of water to be had was small ; and being also uncertain, it was very inconvenient for an undertaker ; neither were there any houses near the spot, which occasioned a great loss of time in going and coming : but when a man should live upon the spot, then he could be ready to seize every opportunity. 2. The moss was an useless waste. To let it to tenants would increase the population of the estate, and afford to a number of industrious people the means of making to themselves a comfortable livelihood.

IN the mean time, it was determined, till as many tenants should be got as could occupy the whole water, to carry on the work by means of undertakers.

BUT, before proceeding farther, it will be necessary to describe the manner of applying water to the purpose of floating the moss.

A STREAM of water sufficient to turn a common corn mill will carry off as much moss as 20 men can throw into it, provided they be stationed at the distance of 100 yards from each other. The first step is to make in the clay, along side of the moss, a drain to convey the water : and for this operation the carse clay below the moss is peculiarly favourable, being perfectly free from stones, and all other extraneous substances, and, at the same time, when moist, slippery as soap : so that not only is it easily dug, but its lubricity greatly facilitates the progress of the water when loaded with moss. The dimensions proper for the grain are found to be two feet for the breadth, and the same for the depth. If smaller, it could not conveniently receive the spadefuls of moss ; if larger, the water would escape, leaving the moss behind. The drain has an inclination of one foot in 100 yards. The more regularly this inclination is observed throughout, the less will the moss be liable to obstructions in its progress with the water. The drain being formed,

the operator marks off, to a convenient extent along side of it, a section of moss 10 feet broad ; the greatest distance from which he can heave his spadeful into the drain. This he repeatedly does till the entire mass be removed down to the clay. He then digs a new drain at the foot of the moss-bank, turns the water into it, and proceeds as before, leaving the moss to pursue its course into the river Forth, a receptacle equally convenient and capacious ; upon the fortunate situation of which, happily forming for several miles the southern boundary of the estate, without the interposition of any neighbouring proprietor, depended the very existence of the whole operations.

WHEN the moss is entirely removed, the clay is found to be incumbered with the roots of different kinds of trees standing in it as they grew, often very large. Their trunks are also frequently found lying beside them. All these are removed by the tenants, often with great labour. In the course of their operations they purposely leave upon the clay a stratum of moss six inches thick. This, in spring, when the season offers, they reduce to ashes, which in a great

measure ensures the first crop. The ground thus cleared is turned over, where the dryness admits, with a plough, and, where too soft, with a spade. A month's exposure to the sun, wind, and frost, reduces the clay to powder, fitting it for the seed in March and April. A crop of oats is the first, which seldom fails of being plentiful, yielding 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. This, as being the first step towards the intended plan, was then viewed as a considerable acquisition. The same terms agreed upon with this tenant have ever since been observed with all the rest. They are as follow :

THE tenant holds eight acres of moss by a tack of 38 years ; he is allowed a proper quantity of timber, and two bolls of oat meal to support him while employed in rearing a house ; the first seven years he pays no rent ; the eighth year he pays one merk Scots ; the ninth year two merks ; and so on, with the addition of one merk yearly till the end of the first nineteen years ; during

the last five years of which he also pays a hen yearly. Upon the commencement of the second nineteen years he begins to pay a yearly rent of 1*l*.s. for each acre of land cleared from moss, and 2*s*. 6*d*. for each acre not cleared, also two hens yearly; a low rent indeed for so fine a soil; but no more than a proper reward for his laborious exertions in acquiring it.

IN the year 1783, Mr Drummond entered into possession of the estate of Blair Drummond, and went fully into the plan adopted by his predecessor for subduing the moss. At this time there still remained undisposed of about 1000 acres of high moss. As water was the greatest desideratum, it was determined that, to obtain that necessary article, neither pains nor expence should be wanting. Steps were accordingly taken to ascertain in what manner it might be procured to most advantage.

As the introduction of an additional stream to the moss was to be a work both of nicety and expence, it was necessary to proceed with caution. For this reason several engineers were employed to make surveys and plans of the different modes

by which it might be procured. In one point they all agreed, that the proper source for furnishing that supply was the river Teith; a large and copious stream that passes within a mile of the moss; but various modes were proposed for effecting that purpose.

To carry a stream from the river by a cut or canal into the moss was found to be impracticable; and Mr Whitworth gave in a plan of a pumping machine, which he was of opinion would answer the purpose extremely well.

Soon after this, Mr George Meikle then at Alloa, a very skilful and ingenious mill-wright, gave in a model of a wheel for raising water entirely of a new construction, of his own and his father's invention jointly. This machine is so exceeding simple, and acts in a manner so easy, natural, and uniform, that a common observer is apt to undervalue the invention: But persons skilled in mechanics view machinery with a very different eye; for to them simplicity is the first recommendation a machine can possess. Accordingly, upon seeing the model set to work, Mr Whitworth, with that candour and liberality of

mind that generally accompany genius and knowledge, not only gave it the greatest praise, but declared that, for the purpose required, it was superior to the machine recommended by himself, and advised it to be adapted without hesitation.

IN consequence of Mr Whitworth's advice, a contract was entered into with Mr Meikle in Spring 1787; and by the end of October in that year, the wheel, pipes, and aqueduct were all completely finished: and what, in so complex and extensive an undertaking, is by no means common, the different branches of the work were so completely executed, and so happily adjusted to each other, that upon trial the effect answered the most sanguine expectations. The total exceeded L. 1000 Sterling.

IT was a remark often made, even by persons of some observation, that by collecting together such a number of people, Kincardine would be over-stocked; and the consequence would be their becoming a burden on the parish; for as the bulk of them were labourers not bred to any trade, and possessed of little stock, it was foreseen

that, for some time, they could not afford to confine themselves solely to the moss, from which the return must be slow; but behoved, for immediate subsistence, to work for daily hire. Happily these predictions have proved entirely groundless; for such is the growing demand for hands in this country, that not only do the whole of these people find employment whenever they choose to look for it, but their wages have been yearly increasing from the time of their first establishment. In short, they have proved to the corner where they are set down a most useful nursery of labourers; and those very farmers who, at first, so strongly opposed their settlement, now fly to them as a sure resource for every purpose of agriculture. Still they consider the moss operations as their principal business; none pay them so well; and when they do leave it to earn a little money, they return with cheerfulness to their proper employment. Many of them already raise from ten to sixty bolls of grain, and have no occasion to go off to other work, which will soon be the case with the whole. Their original stock, indeed, did not often exceed L. 25. and some had not even L. 10; but what was wanting in stock is compensated by industry.

THOUGH moss work be laborious, it is at the same time amusing. The operator moves the moss five feet only at a medium; and the water, like carts in other cases carrying it off as fast as it is thrown in, excites him to activity. Still he must submit to be wet from morning to night. But habit reconciles him to this inconvenience; while his house and arable land fill his eye and cheer his mind. Nor is it found that the health of the inhabitants is in the smallest degree injured either by the nature of the work or the vicinity of the moss.

THE quantity of moss that one man can move in a day is surprising; when he meets with no interruption, seldom less than 48 cubic yards, each weighing 90 stones. The weight, then, of moss moved per day is no less than 4320 stones. A cubic yard is moved into the water, and of course carried into the river Forth for one farthing. It follows that the expence of moving 48 cubic yards is one shilling. But the same quantity moved to the same distance by carts would cost 24 shillings. Hence the advantage derived from the possibility of floating moss in

water, and the great importance of having water for that purpose.

The moss, when contrasted with the rich lands surrounding, appeared, especially before the improvements, a very dreary spot; one wide unvaried wild, totally unproductive, unfit even to furnish sustenance to any animal, except here and there a few wretched straggling sheep. Besides, it entirely cut off all connection betwixt the farms or either side, amongst which no intercourse was practicable but by a circuit of several miles.

AN excellent gravelled road 20 feet wide and a mile and a half long, is now carried quite across the moss. By this means, in the first place, a short and easy intercourse is established between two considerable parts of the estate, formerly as little connected as if separated by a lake or an arm of the sea. Secondly, the inhabitants of the moss, to whom, hitherto, all passage with carts or horses was impracticable for at least one half of the year, have now obtained the essential advantage of being able, with ease, to transport all their different commodities at every season of the

year. This road was entirely formed by the hands of the moss-tenants, and gravelled by their own carts and horses : a work which, it will not be doubted, they performed with much alacrity ; when is considered that, to the prospect of procuring a lasting and material benefit to themselves, there was joined the additional inducement of receiving an immediate supply of money, the whole being done at the proprietor's expence.

THE establishment of this colony has no doubt been attended with a very considerable share of expence and difficulty ; for the undertaking was altogether new, and there were many prejudices against it, which were not easily overcome. At the same time it was noble and interesting ; it was to make a considerable addition to private property ; it was to increase the population of the country, and to give bread to a number of people, many of whom having been turned out of their farms and cottaries in the highlands, might otherwise, by emigration, have been lost to their country ; and that too at a time when, owing to the great enlargement of farms, depopulation prevails but too much even in the low countries.

And it was to add to the arable lands of the kingdom, making many thousand bolls of grain to grow where none ever grew before.

THESE considerations have hitherto preponderated with the proprietors against the various obstacles that presented themselves to the execution of so extensive an undertaking. Should their example tend in any degree to stimulate others, who both in Scotland and in England possess much ground equally useless, to commence similar improvements, it would be a most grateful consideration superadded to the pleasure arising from the progress of the infant colony.

Indeed we consider the removal of Kincardine moss to be an improvement of the greatest magnitude, just such a one as might have been expected from the late Lord Kames, who, as it is well known, possessed genius to devise, and perseverance to carry forward, a work beneficial to himself, or at least to his posterity, and of incalculable benefit to the public interest. We record with pleasure that his son, the present Mr Home Drummond, entered into his views with alacrity, and goes steadily on with the original

scheme, which ultimately must be of incalculable advantage either to him or his descendants. We add that 720 Scots acres are now cleared and in a state of cultivation, and that no fewer than 752 persons of all ages live upon a piece of land which not many years ago was no better than a quag-mire. An improvement of this kind deserves to be mentioned ; nay more, it merits and would obtain thanks from the great council of the nation were internal improvements not entirely disregarded and foreign services alone considered worthy of public notice.

On the whole the liberal and judicious conduct of Mr Home Drummond upon all occasions entitles him to the greatest praise. Last year he expended upwards of two hundred pounds in making roads and other useful works in the moss, and we understand will this year expend a still greater sum on such purposes. This outlay is perfectly gratuitous on his part, as he has already performed every condition incumbent on him by the leases, and looks for no other retribution except what arises from the pleasure of witnessing the increasing prosperity of the colony. The first settlers had leases for 19 years only,

during which (except a small number settled on a thin part of the moss) they paid little or no rent. Afterwards a second term of 19 years was added, during which they pay 12s. per acre *for every acre cleared*. But as the great object was to insure the annihilation of the moss, a few years ago, as a further incitement, a third 19 years was added, during which the settlers are bound to pay one guinea per acre *for every acre in their possession*; and there is not a doubt but that the whole will be cleared before the commencement of that period. It is well known that if the cleared land was out of lease, it would let with ease at three guineas per acre; therefore the liberal system adopted by Mr Drummond stands in no need of demonstration.

SOME other agriculturists have attempted to improve the surface of moss land, and to convert it into fruitful soil by diverse ingenious plans, though we are humbly of opinion that no method can be so effectual and profitable, especially where the moss is incumbent upon rich clay or alluvial soil, as the one adopted by Lord Kames and perserved in by his son Mr Drummond. We understand that the late Mr Erskine of Car-

dross, proprietor of near three thousand acres of the great moss called *Moss Flanders*, which is all incumbent upon a bed of carse clay, attempted for some years to improve the surface of a part of it, and with success, good crops of oats and beans being thereupon produced. Notwithstanding of this, we are informed that his son, the present proprietor, after a further trial, is completely tired of that mode of improvement; and has in contemplation to adopt a plan similar to the one successfully practised on Kincardine moss which we have already elucidated. Indeed, though a field of thin moss may be satisfactorily improved by surface operations, it strikes us that thick fields can only be successfully brought into cultivation by the radical process of removing the surface, or at least the greatest part thereof, and that the removal cannot be accomplished in a cheaper and more effectual way than we have already recommended.

CHAP. III.

ON THE SYSTEM OF FARMING PRACTISED IN GREAT BRITAIN.

SECT. I,

On the Ancient State of Farming in Great Britain.

IN former times, when agriculture was little understood, and still worse executed, the ground was chiefly cultivated on account of the proprietors, by persons retained in their service, who enjoyed or received a certain part of the produce, as a reward for their labour, and for supporting the stock employed in its cultivation. A system of this kind, it is believed, prevailed less or more over all Europe for many centuries, but was

gradually abandoned, as cultivators gathered stock of their own, and were enabled to rent land from the actual proprietors. This rent, in the first instance, consisted chiefly of services, something similar to what prevails in many parts of the highlands and isles of Scotland at this day; it was afterwards changed into the payment of a certain quantity of grain, or articles of produce, as agreed upon between the parties; and finally, as improvements were introduced, and the circulating medium became more plentiful, rent was changed into a money payment; a mode of settling that matter, now generally practised, and certainly more convenient and agreeable than any other, both for proprietor and tenant.

FROM this statement it must be obvious, that the size of farms, in the first instance, would be small and confined, while the condition of the tenant would be abject and poor. A tenant just emancipated from a state of bondage and villeinage, could not easily throw off the chains which formerly shackled his mind, and prevented his natural independence from coming into action; hence many generations passed away before tenants were capable of asserting their just and law-

ful rights, or even before they found out that a single right appertained to them independent of the will of their landlords. This is so well known to have been the ancient state of British tenants, that there is no need of enlarging upon it. They were obliged to follow their chief into the field when called upon, or they were removed from his estate. In fact, before 1449, no tenant in Scotland was secure of possession, as, upon the entrance of a new proprietor, he could be effectually removed without the formality of law; security being obtainable only by the most slavish and implicit obedience. The general situation of the tenantry, under these circumstances, may be easily conceived; and it is wonderful that the country attained such a degree of improvement, when the condition of those by whom it was to be carried on, was so abject and miserable. Exceptions, however, must be made; and these were numerous amongst the tenants of church lands, who were treated much more kindly and affectionately than their brethren, who occupied the lands of the barons. It deserves also to be noticed, that the general state of Scotland under the Scoto-Saxon kings, as already mentioned, was comparatively peaceable,

and that the people were allowed to remain at home, employed in their domestic occupations ; and were rarely called out to meet a foreign invader, or to repel the attacks of a domestic enemy. These circumstances, however, were changed after the decease of Alexander III. the last of the Scoto-Saxon kings. During a period not shorter than seventy years, the country, with little cessation, was engaged in the most cruel wars, which put a stop to every kind of internal improvement, and disposed the people to the practice of rapine and plunder, instead of an honest and industrious life. Nor did the termination of the succession wars, and the establishment of the Stuart family on the throne, restore domestic tranquillity. The different chiefs, acting somewhat like rival monarchs, destroyed and wasted the domains of each other with fire and sword ; and their tenantry, obliged to assist them in these ravages, were exposed in their turn to similar treatment from their antagonists. In such circumstances, husbandry could not flourish ; nor could those engaged in it be either prosperous or happy. In fact, internal peace was not restored, even in the low country districts, till near the end of the 16th century, when James

VI. was firmly seated on the throne, and when law assumed its just controul over the inhabitants.

IN England, the situation of affairs was scarcely more flourishing. Till the end of the 15th century, or the reign of Henry VII. our sister kingdom had continued in a state either of domestic or foreign warfare; during which the tenantry were called into the field at the pleasure of their respective chiefs, and exposed to death and destruction, without having any real interest in the quarrels in which they engaged. The tenantry of England, however, were better off than those in Scotland, because civil disturbances did not prevail so often, nor was their country invaded and ravaged, as Scotland repeatedly was, during the reigns of the three first Edwards. It was only the northern counties of England that were exposed to the partial inroads of the Scotch, and these were the most barren and uncultivated of the whole; whereas the best parts of Scotland, lying nearest to the enemy, always suffered most, whilst the northern and uncultivated districts generally escaped.

UNDER these adverse circumstances, husbandry, which of all arts is the one most exposed to the destroying hand of an enemy, could not prosper, nor could those who practised it advance far either in political or moral improvement. Farms continued to be of small size, and perhaps were preserved in that state, so as the number of followers might be increased as much as possible. The introduction of summer fallow into Scotland, at so late a period as the end of the 17th century, furnishes a strong proof that agriculture long remained in a neglected state in that country.



SECT. II.

Causes of the Superiority of British Farming.

BRITISH farming, though far from being perfect, may be considered as much superior to that of the continent. This superiority arises from the more general security of property; from the

beneficial nature of the tenures under which land is occupied ; from the greater diffusion of wealth among agriculturists ; from the partial use of machinery, and the general attention paid to the construction of implements for agricultural operations ; from the education bestowed upon agriculturists ; from the intimate union betwixt grass and corn husbandry, by which both are greatly benefited ; and from the goodness and steadiness of markets, where the several articles of produce are converted into money. Each of these causes has assisted in promoting British farming, though in different degrees, according as they have been brought into action, or in proportion to the force with which they operated. The first, fourth, and last, are general causes, whose effects are alike beneficial in every situation ; but the others are affected by local circumstances, and vary considerably in different districts, especially in South and North Britain. We shall enlarge a little upon these causes of superiority, and illustrate their effects in promoting the husbandry of Great Britain.

IN the *first* place, the security given to property through the whole of the British empire,

ensures to every man the complete possession of what his industry acquires, with the exception of that proportion of it which is necessarily taken for the protection and defence of the empire. When mankind are subject to arbitrary exactions, and their property is wrested from them at the pleasure of another, industry never can flourish. Under such circumstances, labour may be exerted to a degree sufficient to procure the necessaries of life, but it rarely goes farther. In Britain, however, every man may be said to possess the full fruits of his industry and exertion, and may use and appropriate these fruits in any manner he thinks fit, provided it is not injurious to his neighbour, or the welfare of the community of which he is a member.

IN the *second* place, the tenures under which land is occupied, are favourable to improvement. Here we are well aware, that a general extension of the leasehold system would contribute much to the prosperity of agriculture; because, where leases are withheld, a strong encouragement is manifestly wanting. On this point, however, we shall not now insist; though it deserves attention, that to the tenure of holding by lease, may be

attributed the striking and manifold improvements accomplished by British tenantry. Their exertions are stimulated by the conviction that they are improving for themselves, and that none can step between them and the proposed benefit, so long as they act agreeably to the obligations of the tenure, in virtue of which they have possession for a limited term. Leases have long been more prevalent in Scotland than in England; and to this prevalence may be imputed the superiority of improvements discernible in the former country. One hundred years ago, England was in every respect the better cultivated country, though in modern times the husbandry of Scotland has advanced with such rapidity, as now to equal that of England, local circumstances considered. The leasehold tenure has of late been discouraged in England, and the tenantry forced to trust to the generosity of the proprietors. According to our principles, a manifest obstruction to improvement is thereby created; because the most implicit confidence does not furnish security equal to that conferred by a lease. Allowing that confidence may be safely reposed in the honour of the existing proprietor, what is to become of the tenant in the event of

his decease, when the estate goes into other hands? Here honour does not interfere, and the occupier may be turned from his farm, without any violation of that sacred principle.

IN the *third* place, the general diffusion of wealth in Great Britain is of vast importance to the art of husbandry. It is an old saying, though not the less true on that account, that the poor farmer is always a bad one. Though wealth does not necessarily cause the farmer to excel in professional practice, yet without it the most scientific knowledge must be in a great measure useless and unavailing. The British farmer being therefore in general cases better supplied with capital stock than farmers on the continent, he is enabled to exceed their exertions both in the execution of old practices, and in searching after new ones.

IN the *fourth* place, the partial use of machinery, and the general attention paid to the construction of implements for executing agricultural work, are circumstances of infinite advantage to British farming. Machines for thrashing grain from the straw, whereby the separation is more

completely performed than by hand-labour, or any other method, are now become very common; whilst fanners, for dressing the grain, are in the possession of almost every farmer. Machinery for breaking or grinding grain for horse food is likewise erected on the majority of great farms. But the general attention shewn to the construction of the other implements used in carrying on the operations of husbandry, such as ploughs, harrows, drills, rollers, carts, waggons, and the like, is of incalculable benefit to British farming; and enables those who carry it on to execute every branch of work in the most perfect and profitable manner. With respect to these necessary implements, perhaps no country in the world furnishes tradesmen, or artificers capable of constructing them, with greater dexterity, and at so small an expence as those of Britain. With respect to thrashing machines, the remark is particularly appropriate; those erected on the continent being in every respect defective in strength, and incapable of executing, at the same expence, and with the same effect, the important work of separating corn from the straw; one which husbandmen in all ages have considered as the most arduous one connected with their profession.

EVEN the general conveniency of farm buildings, and the comfortable accommodation provided almost in every situation, not only for the husbandman, but also for his servants and live-stock, furnish great encouragement to British farming. When we see a country naked and bare, from want of inclosures; when we notice farm-houses small, badly constructed, and imperfectly finished; when we observe the other buildings mean, irregular, and unfit for the reception of live-stock; very little consideration is required to ascertain the existing state of husbandry in a district or country to which such a description is applicable. Generally speaking, under such circumstances, agriculture will always be found defective, while the condition of the husbandman, and those dependant on him, will likewise be found poor and uncomfortable. The British farmer, however, is rarely unprovided with suitable accommodation for himself, his servants, and his live-stock, and thus enjoying sufficient encouragement to execute the duties of his profession. Exceptions there are to this rule, and these exceptions will, in the nature of things, remain in some degree; but they do not invalidate the truth of what we are inculcating, name-

ly, that British farming is greatly supported by the comfortable and substantial buildings generally erected for the accommodation of those engaged in that profession.

In the *fifth* place, the great body of cultivators in Great Britain, whose farms are of any considerable extent, have generally received a suitable education, by which their minds are enlarged; animated with a desire to improve their condition in the world, and rendered equally quick to perceive, and ready to adopt, such improvements as may occasionally be proposed. In former times it was objected, that farmers were an obstinate and bigotted class of men, averse to every kind of innovation upon established practice, and persisting in ancient systems, even after their deficiency and inutility had been ascertained in the most decisive manner. Whatever truth there might formerly be in the objection, its force is now completely removed; there being no set of men whatever more open to conviction, or more willing to adopt new practices, than British farmers of the present day. This change of disposition has been accomplished by a general circulation of agricultural knowledge, since the na-

tional Board of Agriculture was established ; by numerous periodical publications upon rural economy ; and by that increase of wealth which flowed from the exertions of the farmer, and which naturally stimulated a search after new improvements. According to the measure of attention bestowed upon the education of farmers, it may be expected that improvement will hereafter advance. A man of uncultivated mind may hold a plough, or drive a harrow, in a sufficient manner ; but he will seldom introduce an improvement, or be the means of effecting any change in the established system of rural economy.

IN the *sixth* place, the intimate connection betwixt grass and corn husbandry has been of high advantage to British farming. This union is closer in Britain than in any country in Europe, Flanders excepted, and might still be more firmly cemented, were alternate husbandry brought into general practice. This cannot happen, however, in many districts of England, till all land be held in severalty, and the range of old pastures and meadows be subjected to the plough. There is little appearance at present of these beneficial

alterations being soon adopted, though few arguments are required to prove, that numerous advantages would follow, were alternate husbandry generally introduced.

THE kinds of land on which alternate husbandry cannot be exercised under present circumstances, were the occupiers ever so willing to adopt it, are, *1st*, what is called Common Field, where property is mixed; and, *2d*, what is called Waste Common, where the subsoil belongs to the lord of the manor, and the surface to a class of people having servitude upon it. According to the common field tenure, no new practice can be introduced, unless with the approbation of every one concerned; and it would be saying too much for the good sense of mankind, to reckon upon such a degree of unanimity in a single instance. As for the waste land, it is condemned to sterility, by the laws of the country supporting a mode of tenure inconsistent with national prosperity. Various attempts have been made by the Board of Agriculture, to procure a law for regulating a general division of common and waste land, though, from the clashing of various interests, unfortunately without success. The ad-

vantages which would follow a law of this kind are so numerous, that a wise legislature would rather cut a knot that cannot be loosened, than suffer the nation to remain without such advantages.

WHEN a question of this nature is under discussion, the proper way of arguing it is to enquire, whether the holding of land in commonty, or severalty, is most conducive to the public good? or, in other words, whether the ground is most productive under the one tenure or the other? It is the improvement of the country which we ought to have in view, and not the augmentation of individual property; and, even supposing that private rights may be partially injured, yet if a general division of these common fields and wastes will increase the quantity of corn or live stock, the interest of the country is thereby promoted. Now, as no land can be improved when lying in commonty, it follows, that putting it in that state which allows the proprietor to cultivate and manure it as he pleases, must be a necessary measure, and that the object justly deserves the most serious attention of the legislature.

IN the *last* place, the goodness and steadiness of markets in Britain, for disposing of the articles of produce raised by the British farmer, may be mentioned as a principal mean of securing the superiority of our husbandry over that of other nations. We need hardly employ a single minute in illustrating this position, because its truth is abundantly manifest. No trade can prosper when its articles are not in demand; or, more properly speaking, when the market demand for the article to be vended is inferior to the quantity offered for sale. With respect to the articles produced by the British farmer, the demand generally equals, and often exceeds the quantity which he rears; he has every encouragement to increase the quantity of his produce, as it may be instantly disposed of at market for money, without lying upon his hands, or giving him unnecessary trouble. Hence a degree of encouragement is given to British farmers, far exceeding what is enjoyed by those of the continent, where prices are not only more unsteady, but where a regular demand is also wanting for the productions of the agriculturist.

FROM these considerations it will in some measure appear, that the British farmer is placed in a preferable situation to that of his brethren on the continent. Foreigners, who visit this country, are often puzzled to assign reasons for the superiority of British farming, when compared with that of other countries. They one and all acknowledge, that greater energy is displayed by the British farmer; that the land is better ploughed; that it is more regularly and systematically cultivated; that the crops raised are heavier, and apparently more productive; and in short, that the agriculturist appears in a more elevated situation than with them; but of the causes which occasion the difference betwixt British and foreign agriculture, they at the same time candidly acknowledge themselves totally ignorant. We have stated these causes, therefore, in a cursory manner; and are confident that the difference might still be rendered wider, were the obstacles to the improvement of British husbandry, hitherto slightly noticed, completely done away, or gradually diminished.

SECT. III.

On the Size of Farms.

WHERE farming is carried on as a separate profession, and those engaged in it are provided with an ample capital stock, it is plain that a farm ought to be of such a size as to furnish regular employment, not only to the master farmer, but also to servants of every description kept on the premises, so that the greatest possible return may be made to their labour, and at the least possible expence. The immense advantages of a regular division of labour, in the process of manufactures, has been long well understood; but it is only of late that it was thought practicable to extend these advantages to the business of agriculture. Formerly, the man who held the plough wrought with the sickle in harvest, and wielded the flail through the winter season. At one time he cut grass with the scythe, and at another digged ditches with the spade; putting his hand to every branch of labour, while his horses cooled their heels in the stable, or ranged

the scanty pastures in search of food. This is a just representation of the ploughman's avocations in former times ; and it is only of late that his labour has been more correctly arranged. He is now limited to his proper department ; and in all well regulated farms, servants are provided for executing other branches of work, by which means the charge of labour is not only lessened, but the several processes are executed with greater perfection than was practicable under the ancient system.

FROM these preliminary remarks, it will be discovered, that a farm must necessarily be of considerable extent before the benefits arising from a division of labour can be fully obtained. Upon a farm comparatively small, these advantages, under the best arrangement, can only be partially gained, because regular employment cannot be furnished to any servant except the ploughman ; labour, therefore, cannot be suitably divided, or even executed, at the same expence as if the concern were of a more extensive nature. In this point of view, the public interest seems benefited by large farms, though theorists have long contended that such should be ex-

pressly prohibited by legislative enactments. The opinion which we have formed on this question differs from that entertained by these gentlemen ; and being founded on practical principles, may be of use, when this important question comes under consideration. We are not advocates for monopoly ; though convinced, that an extensive farm, provided the capital stock, and abilities of the occupier, are adequate, operates not only as a spur to activity and diligence, but may be managed at less expence, and in a more perfect way, than is practicable, were the same quantity of ground divided into a number of small farms. The justness of these opinions may appear from the following considerations.

AN improved system of husbandry requires, that the farm upon which it is to be carried on should be of some extent, otherwise room is not afforded for the different crops necessary to complete a perfect rotation of management. The farmer, who practises husbandry upon proper principles, should not only have his fields under all sorts of grain, but likewise a sufficient quantity of grass and winter crops, for maintaining his stock of cattle and sheep through all the different seasons

of the year. By laying out land in this style, the economy of a farm is so regulated, that while improvements progressively go forward, too much work does not occur at one time, nor occasion for idleness at another. When the expences of farm culture are so extravagant as at present, this deserves particular attention ; but cannot, in the nature of things, be justly and accurately arranged, where the farm is of small size.

IT has surprised us to observe many persons taking it for granted, that, by increasing the size of a farm you necessarily decrease the number of the people ; without considering that, if the management is equal in every respect, the population must be exactly the same, with the exception of one or two farmer's families. They tell you that cottages are pulled down ; whereas the large farmer has occasion for more cottages than the small farmer, as he cannot keep so many house servants, and is often under the necessity of building new houses, in order that the number of servants he keeps may be accommodated. An attentive observer will smile at the doleful pictures often exhibited by such alarmists, which,

to do them justice, are not original ones, as they have been borrowed from former times. In a word, wherever work is carried on, it must be done by employing hands ; and wherever work is executed in the most perfect manner, the greatest number of hands must be employed. If the system carried on upon the premises is improved, the population must of course be increased ; the one is the cause, the other is the effect, and practice and daily experience justify these conclusions.

SECT. IV.

On Hiring or Renting a Farm.

THE farmer, who wishes to hire or rent a farm, should, upon such an occasion, call forth all his abilities. He should equally attend to the disadvantages, and to the advantages of the farm, that he may be able to draw a balance, and compare that balance with the rent demanded. Let

him remember, that he must equally discard a too solicitous prudence, which doubts every benefit, and a too daring courage, which overlooks or lessens every evil.

It must be obvious to almost every person, that common farmers often lose themselves in deliberating concerning a farm. They have so many mistaken rules of judging, that they often reject farms that soon after make the fortunes of those who rent them. In particular, they are very apt to take one false guide,—the success of the last tenant. If a man makes a good deal of money upon a farm, or leaves it for a much larger one, numbers will immediately apply, almost without viewing it; but, if a tenant fails, most of the neighbours take it for granted, without further consideration, that the farm is a bad one. They attribute all to the land, and avoid it, under an idea that, without a reduction of rent, the farm cannot be a profitable concern. These notions are absurd in the extreme; for the management of various farmers is so essentially different, that success often depends very little on rent. A farmer, with a proper sum of money in his pocket, hires a farm, and thrives upon it;

another, with a hundred pounds less, hires it, and starves. Suppose two farmers of the same substance, and living upon similar farms: one manages his land with judgment and spirit; makes all the manure he can; sells no hay or straw; does not injudiciously crop his land; drains his fields, and keeps his fences in good order. This man grows rich. The other, a sloven in these particulars, dwindles into poverty. These are the circumstances that make the one man rich, and the other poor; and surely it must be apparent, that those who judge of the value of land by the success of others, take as false a criterion as they can possibly fix upon.

LET the farmer who is debating whether he should hire a farm that is offered him, examine the soil well, that he may be enabled to determine its nature, with respect to stiffness, moisture, exposure, levelness, slope, stoniness, &c. Let him estimate the expence of draining, manuring, and fencing, that will be required: let him take into consideration the roads, distance of markets, prices of commodities, labour, &c. The compactness of the farm, and the situation of the homestead, should also be well considered. One

general rule, in hiring a farm, should never be forgotten : The farmer should, if possible, fix upon good land, and he can scarcely pay too much for it ; but, for poor land, the least rent is often too high. By good land, however, we are not to understand that which has the command of lasting manures, as marl, &c. ; neither are we to consider lands as unprofitable which pass under the denomination of *waste*, for such, though uncultivated, are often of the richest quality.

THESE are considerations of great importance. It may also be added, that the mellow, rich, crumbling clays, or rather clayey loams, are of all soils the most profitable. Regard such as best which will admit of being ploughed soon after rain, and do not cake on hot gleams of sun coming soon after : lands of that quality are of the greatest value, and will be preferred by every judicious husbandman.

ANOTHER consideration of great importance is, not to take a farm that may require more money to stock it well than the farmer is in possession of. Farmers are usually very eager after quantity ; the certain consequence of which is,

a slovenly system of management. Let any one consider the difference between good and bad husbandry in all its branches. The one is a certain loss ; the other a certain gain. A profitable and proper use of natural manures, as lime, &c. can only be made by those farmers who have money at command. In the neighbourhood of great cities and towns, a variety of manures are to be had, and in some places at a reasonable price ; but, without the command of money, how are these to be obtained ?

As in land, so in manures, quality is to be considered above quantity ; but this is a distinction that many farmers are unable to make, and yet it is a thing of the utmost importance. Animals require food of a good quality, and reject that which is bad ; but vegetables, being of a passive nature, can only show their dislike by a feeble and unhealthy appearance when growing.

LET the farmer ever hold in remembrance, that manure is the life and soul of husbandry ; therefore those who know best how to prepare it, and afterwards how to apply it, can scarcely

fail of being successful in any situation, unless the land is over-rented.

SECT. V.

On the Occupation of the Soil.

THE portion of land in Britain kept in the hands of proprietors is comparatively very small, ninety-nine parts out of a hundred at least being demised by lease or agreement to tenants for a greater or lesser number of years, under certain conditions or prestations, which govern their management, and ascertain the terms under which possession is to be held during the years agreed upon. This is a wise system for proprietors to act upon, because, without the aid of the tenantry, it is morally and physically impracticable to procure a suitable return from their estates, or even to have them cultivated or improved to an extent in any measure adequate to their natural

value. There are exceptions, however, to this rule, but they are not numerous. We have seen some proprietors improve lands in their possession as well as could have been done by the most correct farmer, though perhaps at a greater expence. This must necessarily happen from the latter being always at the head of affairs, whereas the other must depute the management to a bailiff or steward, whose interest is not materially concerned in the issue.

AGRICULTURE in Britain is therefore carried on by farmers, who rent the land on such terms as can be agreed upon, and, in most cases, upon a lease of longer or shorter duration, as is customary upon the estate, or agreeable to the wishes of the proprietor. Generally speaking, the length of a lease is from 19 to 21 years, at least in North Britain. In some cases it is not so long; but it is evident that, when land is in an unimproved condition, a greater number of years is necessary to excite the tenant to make improvements, because he cannot otherwise have time to reap the fruits of his labours. The value of land, for the last twenty years, has increased so rapidly, that most proprietors are averse to grant a long

lease, though it is demonstrable that, by shortening the period, the permanent interest of the property will not be advanced. A greater or less number of restrictive covenants are usually inserted in leases, many of them undoubtedly detrimental to the tenant, without being of the slightest benefit to the proprietor. When leases are from year to year, or the tenant is removable upon six months warning, a practice very frequent in England, strict covenants may be necessary; because the tenant, having no more than an annual interest in the premises, might be led to sacrifice every principle of good husbandry, and to ruin the ground committed to his management; but where the lease is for 19 or 21 years, covenants of any kind, except the one relative to annual rent, seem altogether useless, unless in so far as relates to the four last years, when the interest of the parties may clash or interfere. Even then, nothing more is necessary than covenants respecting grass and fallow, houses and fences; for, in the other years, the interest of the tenant is a stronger motive to the performance of duty than the most express written obligations.

THE growing of corn may be considered as the chief object of British farmers ; though, in many of the inland districts, the grazing system is more extensively followed, and little grain cultivated, except what is required for the consumption of the neighbouring inhabitants. Perhaps the most perfect system of husbandry is that which conjoins the corn and grazing trade, usually called the alternate husbandry, where two culmiferous crops do not follow in rotation, but grass, or one or other of the leguminous varieties, succeed each corn crop. If this system be diligently exercised, it is not a matter of much importance what varieties either of culmiferous or leguminous articles are cultivated, because the soil may be equally benefited ; though local circumstances may render it for the interest of the tenant to cultivate one kind in preference to another. The alternate husbandry prevails more in Britain than in any part of Europe, Flanders excepted, and is rapidly spreading in every district. In fact, a system of that nature is eminently beneficial to every soil, and most advantageous for the tenant, though the crops to be cultivated depend entirely upon soil and climate. These vary so much in Britain, as to preclude

didactic rules concerning the crops which may be most profitably cultivated ; but, where the soil and climate are favourable, and manure is at the command of the tenant, wheat always forms a prominent article of British culture. So much of the soil, however, is of inferior quality, and the climate in many districts so unfavourable to the growth of that grain, as to render the culture of oats in many cases more beneficial. Wheat is indeed now cultivated in Britain to an extent almost equal to the consumption of the inhabitants, notwithstanding the general predilection for bread made from that grain, which furnishes a good reason for bringing waste ground scattered up and down the island into immediate cultivation. Without adopting a measure of this nature, the country cannot be furnished with a regular supply of grain without the aid of foreign nations ; and this aid, under existing circumstances, must be viewed, not only as precarious and uncertain, but as placing the country in a state of dependence, which every considerate person must certainly deprecate.

NOTWITHSTANDING all the advantages which are enjoyed, perfect husbandry is not to be looked

for in Great Britain, unless leases are more generally granted, and a greater degree of liberty allowed to the tenant, than hitherto enjoyed under the customary covenants. Perhaps the leasehold tenure is more frequent in Britain, and discretionary management more prevalent than in other countries. To these things, and the security afforded to property by a wise system of laws, may the superiority of British husbandry be chiefly attributed. Several other advantages have been noticed in a former section, and the whole connected together are eminently beneficial to the prosperity of the state. A wise economist would, however, study to increase these advantages. To do away every obstacle in the road of improvement, would by him be considered as an important service to the community. The art of agriculture has been viewed as the parent whence all others spring; therefore the more the parent art is improved, so much more encouragement will be afforded to the increase of the inferior ones. This island has already derived numerous advantages from the increased attention shewn to the improvement of its agriculture; and it is to be hoped this attention will continue to increase, thereby furnishing a constant aid to na-

tional prosperity. The decline of agriculture would be the surest symptom of national ruin. Britain hitherto has matched any part of the world in a knowledge of the arts, and in the practice of trade and manufactures. The origin of that knowledge, and the source of these practices, may, in some measure, be traced to the improvement of its agriculture. This art forms the basis or foundation on which all others are reared ; and as it is more perfect in Britain than in other countries, commerce and manufactures have risen to proportional excellence.

CHAP. IV.

ON THE SYSTEM OF CONNECTION BETWIXT PROPRIETORS AND TENANTS IN GREAT BRITAIN.

THE bond of connection between proprietors and tenants, or the nature of the system which connects these two classes together, is of much more importance to the cause of agriculture than many of our writers on rural economy seem to imagine. In fact, the moral excitement, or degree of encouragement given to the tenant for improving the ground which he occupies, is regulated entirely by the terms or conditions of the

lease under which he holds possession. If the conditions be liberal and judicious, and accommodated to the soil and situation of the land thereby demised to the tenant, all that is obligatory upon the proprietor is faithfully discharged. But, when matters are otherwise, when the tenant possesses under a short lease; when the covenants or obligations are severe in the first instance, and ultimately of little avail towards forwarding improvement, it may reasonably be inferred, that the connection is improperly constituted, and that little benefit will thence follow either to the public, or to the parties concerned.



SECT. I.

On Leases.

HOLDING land under lease is a very ancient tenure in Britain, though the obligations of that instrument have varied and altered materially

since the tenure was first established. We have already, in a cursory manner, pointed out the utility of leases, and described the ancient state of the agriculturists of this country. We considered the original cultivators as persons who managed the ground in behalf of the proprietors, and to whom a certain proportion of the produce was allotted for the maintenance of themselves and those under them. They possessed no stock of their own, but acted merely as servants of the proprietors, who furnished the means by which cultivation was carried on, and they were liable for the value of stock put into their hands, and the remainder of their produce after their own allowance and the expence of management were defrayed. This view of the husbandman's situation in ancient times, accords with the accounts given of it by the late Lord Kames, an authority of no small consideration, and indeed is analogous with the state of property and society at the time, and quite consistent with the records transmitted to us. His Lordship says, that "lands were originally occupied by bondmen, who were the property of the landlord, and consequently not capable to hold any property of their own; but, such persons, who had no interest to be in-

dustrious, and who were under no compulsion when not under the eye of their master, were generally lazy, and always careless. This made it eligible to have a free man to manage the farm, who, probably, at first got some acres set apart to him for his maintenance and wages. But this not being a sufficient spur to industry, it was found a salutary measure to assume this man as a partner, by communicating to him a proportion of the product, in place of wages, by which he came to manage for his own interest as well as that of his master. The next step had still a better effect, entitling the master to a yearly quantity certain, and the overplus to remain with the servant. By this contract, the benefit of the servant's industry accrued wholly to himself, and his indolence or ignorance hurt himself alone. One further step was necessary to bring the contract to its due perfection, which was to give the servant a lease for years, without which he could not be secure that his industry would turn to his own profit. By a contract in these terms, he acquired the name of tenant, because he was entitled to hold the possession for years certain."

LANDED property in this country was held on very slight security till the reigns of the Soto-Saxon monarchs of Scotland; since which property has been possessed nearly under the same tenures, though not under the same burdens, as at this day. But though the possession of property may be considered as uniformly held under the crown, yet the situation of those who bore the heat and burden of the day, those who laboured the ground and made it productive, was vastly dissimilar. Originally there was no description of property in the country, except the soil and the animals reared upon it; therefore, when the soil was portioned out and allocated amongst those to whom the sovereign was pleased to grant it, the remainder of the people, left unprovided, were to all intents and purposes entirely dependent upon those on whom land had been bestowed; because, from the situation of the country at the time, no other resource or means of support was to be found. The proprietors who obtained grants of land from the crown, conveyed part of it to their principal dependents, as feudatories or vassals; and from the circumstances of charter and seisin being taken upon these conveyances, it has been supposed

that leasehold was a tenure of very ancient date. There is reason, however, to assert, that leases were unknown, at least in Scotland, till the clergy obtained landed possessions; and that the like tenure was afterwards extended to the tenants of the lay proprietors, as the country increased in wealth, and as the circumstances and condition of the actual cultivators were improved and meliorated. Not sooner than 1449, however, was any tenant secure of possession, though the clauses of his lease were ever so strong; nor was he secured against the claims of the proprietor's creditors till twenty years afterwards, viz. 1469, in the reign of James III. (a monarch who received a character from many historians which he did not deserve), when an act passed freeing the tenant from all claims exceeding the actual rents due by him. In England, the tenant seems to have remained longer in an insecure and precarious state than even in Scotland; for till the act 20th Henry VIII. was passed, any tenant might be ejected by the form of process, called a common recovery. From these circumstances, the degraded condition of cultivators or farmers in ancient times will easily be ascertained; and from what will afterwards appear, their condi-

tion does not seem to be so much improved as imperiously called for upon principles calculated to promote the public interest. The prosperity of the state is at all times intimately connected with the successful cultivation of the soil, and the increase of agricultural produce; every circumstance, therefore, prejudicial to the one, is necessarily prejudicial to the other.

VIEWING farmers as standing in the condition of proprietors, and exposed to the same difficulties that would occur to the latter, were the cultivation of the ground to be carried on at their risk and expence, we must consider every unnecessary hardship imposed upon them, and every obstruction thrown in the way of spirited cultivation, as tending for the time to lessen the real value of the property, and as injurious to the interest of the state. If a certain number of years must elapse before the best concerted plan can be carried fully into execution; and if another number of years must expire before the fruits of that plan can be reaped or obtained, then it would appear that the proprietor, who either obstinately refuses to let his land upon lease, or to grant to the tenant such a lease as shall ensure

him a reasonable term of possession for reaping the fruits of improvement, must be considered not only as highly culpable, but guilty of a kind of high treason against the prosperity of the state. On the other hand, proprietors who grant leases, and include in them covenants or obligations that obstruct the operations of the farmer, or, which is the same thing, prevent him from raising the greatest possible quantity of produce for the use of the community, must also be regarded as enemies of the public welfare. If agriculture is a main pillar of the state, every measure tending to injure or reduce its strength, must be considered as hostile to the community, and deserving of the severest censure and reprobation.

BEFORE a farm can be put in proper order, a considerable time must elapse, and much money must be expended. The fruits of improvements cannot be gained all at once, and a number of years are required to accomplish the best digested plan. Suppose, for instance, a person entering to a farm worn out and exhausted by long and successive tillage, and that he wishes to refresh the land by laying it down in grass; it will be six years at least before he can go over it all

with fallow ; and unless he sow it down clean, he is neither doing the land nor himself justice. If he continues it in grass five or six years more, which is little enough time for ground so exhausted, it will be found that near twenty years must elapse before he can receive the reward of his improved cultivation ; and to receive this reward, he has a claim both from his superior management, and as an incitement to his future industry : but what security has he for this reward, or what incentive has he to industry, if he sits upon the premises by virtue of an annual agreement ? In the midst of his career, he may be interrupted by a *six months warning*, and the toil of his hands, and the fruits of his improvements, be transferred to another. These are not imaginary apprehensions, but are founded upon real and solid principles ; and will operate less or more upon every farmer, according to his situation and circumstances.

MANY cases of a similar nature might be put ; but from the above we hope it will appear, that before any substantial improvements can be expected from the farmer, he must have the security of a lease, for affording him time to reap the

fruits of these improvements. There is, in the course of farming, as much often laid out in one year, as many succeeding crops can repay * ; in this case, where the farmer has a lease, he looks to a future period for being reimbursed: if he has none, can it ever be expected that any man

* We may give one instance to corroborate what is here said. A farmer of our acquaintance had an acre of rich mossy meadow ground, which was totally unfit for ploughing, and scarcely capable of carrying a beast in the driest summer months. In order to make it crop with the rest of the field, he drained it completely; and as, from the strength of the roots of the herbage, it would not plough to advantage, he dug the whole of it with the spade. After taking a crop of corn he summer fallowed and limed the ground.

The expences were,

Casting drains,	-	-	-	L. 4	15	0
Gathering stones, driving them, and filling up the drains,	-	-	-	5	18	0
Digging the ground, which, from the strength of the roots, was a severe operation,				4	10	0
Lime and carriage,	-	-	-	6	0	0
				<hr/>		
Total expence,				L. 21	3	0

Query, Would the farmer have improved this meadow with out a lease?

of common sense will throw away his money by improving another person's estate, and cast himself upon the mercy and discretion of his landlord for time and opportunity to gain it back again? The farmer who would do this, is not guided by those principles which influence the rest of mankind.

WITHOUT insisting further in favour of leases, it may only be added, that this salutary tenure prevails almost through the whole of Scotland, and perhaps in one half of England. If it is true, as stated by Mr Arthur Young, "*That the improvements, which have taken place in England, have been almost always owing to the custom of granting leases, and that, in those counties, where it is unusual to grant them, agriculture continues much inferior to what it is to be found where they are usual,*" the question concerning their utility is at end; and the culpability of every proprietor who refuses to invest his tenant with such a security, is completely ascertained. The proprietor who acts in such a way not only lessens the value of his estate, in the first instance, but ultimately injures the interests of the community, in so far as the improvement of agriculture is

thereby retarded. The subject is of such importance as to deserve the attention of the legislature. Assuredly no object is more worthy of notice from the guardians of the state, than one which effects its vital interests; and though a commendable delicacy prevails against any interference with the management of private property, yet there are certain bounds within which that delicacy ought to be confined, and beyond which the conduct of proprietors should be investigated and restricted. Those who persist in a refusal of leases, or, which is the same thing, impede the progress of improvements, deserve to be viewed as persons unfriendly to the national welfare.

THE benefit of leases has been strikingly exemplified in the low-country districts of Scotland. There the tenantry, one or two estates excepted, are secured in possession either for 19 or 21 years, and sometimes for a longer period. Hence a rapid improvement of the country has taken place, and great and substantial undertakings have been executed, which no man in his senses would have planned, far less executed, had the security of a lease been withheld. Excellent farm-houses and offices have in conse-

quence been erected, open fields have been inclosed, wet lands have been drained, and unproductive wastes brought into a high state of cultivation. From these circumstances, the rentals of proprietors have increased at an amazing rate, without their being subjected to any expence in procuring the increase. Since 1790, the rent of land in Scotland has increased in a twofold degree above that of England, solely because the system of connection between the proprietor and the occupier is formed upon more liberal terms in the one country than in the other. Were the liberal system in Scotland to be imitated in England, there is no doubt but that the consequent advantages would be greater; because soil, climate, markets, and other local circumstances, are much more favourable to agriculture in the latter than in the former country. To grant leases is one step towards procuring these advantages, but more is still required; namely, that a kind of discretionary management be entrusted to the tenant. If this be not done, his mind will continue fettered as formerly, [and his operations be confined to the beaten path of ancient usage.

AFTER all, though long leases can alone lead to improvements of permanent duration ; yet, nevertheless, towards the close of every lease, there must be an unimproving period, during which melioration on the part of the tenant will cease, and where the compulsion of regulation must be substituted to enforce improvement. A compulsion of this kind, however, generally proves a weak and inefficient substitute for the more powerful motive of private interest, and seldom accomplishes the benefit intended to be produced.

To remedy this defect, Lord Kames, who probably was the first man in Britain who considered farming in the view of its proper moral excitements, suggested the indefinite or perpetual lease. His Lordship proposed that the lease should extend to an indefinite number of years, consisting of fixed periods, at the end of which a rise of rent should take place, with permission for the tenant, at the period of each of these rises of rent, to give up his farm if he shall see proper, and granting a similar power to the landlord, upon proper terms, to resume his land if he shall think fit. The particulars of this contract, and the grounds on which they rest, are as follows.

HIS Lordship assumes it as a principle, that a landlord and a tenant are capable of forming a tolerably just estimate of the value of the land in question, for a short period of years, such as it is customary to grant leases for in Scotland, say 21 years; and having agreed upon these terms, which, for the present, we shall call L. 100 rent, the tenant expresses a wish to have his lease extended to a longer period. To this the proprietor objects, on the principle that it is not possible to form a precise estimate of what value the ground may be at the end of that period. He has already seen that ground for the last 21 years has increased much more in value than any person at the beginning of that period could easily have conceived it would have done, therefore cannot think of extending the lease for a longer period, as a similar rise of value may be expected to take place in future. This reasoning appears to be well founded; and, therefore, to give the landlord a reasonable gratification, he proposes that it should be stipulated, that if the tenant should agree to give a certain rise of rent at the end of that period, suppose L. 20, the landlord should consent that the lease should run on for another

period of 21 years, unless in the cases to be hereafter mentioned.

BUT as it may happen that this L.20, now stipulated to be paid at so distant a period, may be more than the farmer will find he is able to pay, it shall in this case be in his power to resign his lease, on giving the landlord legal notice, one year at least, before the expiry thereof; but if that notice be omitted, it shall be understood that the tenant is bound to hold the lease for the second 21 years, at the rent specified in the contract; and if the landlord does not give the tenant warning within one month after that period, it shall be understood that he too is bound to accept of the stipulated additional rent for the 21 years that are to succeed.

IT may, however, also happen, that the sum specified in the lease may be a rent considerably below the then present value of the farm; or the proprietor may have reasons for wishing to resume the possession of that land, or to obtain an adequate rent for it; a power, therefore, should be given to him, in either case, to resume the lands if he should so incline. But, as a great

part of that present value may be owing to the exertions of the farmer, who has laid out money upon the farm, in the hopes of enjoying it for a second period of 21 years, it would be unjust to deprive him of his benefit without giving him a valuable compensation for that improved value. On this account, it should be stipulated that, in case the proprietor, at this time, resumes the farm, he shall become bound to pay to the tenant TEN years purchase of the additional rent he had agreed to pay ; which, in the example above stated, would be L.200.

BUT the land may be worth still more than the L.200 rise mentioned in the lease, and the tenant may be content to pay more, say L.10, rather than remove ; and he makes offer accordingly to do so. In that case, the landlord should be bound, either to accept that additional offer, or to pay TEN years purchase of that also ; and so on for every other offer the tenant shall make before he agrees to remove from the farm.

IN this way, the landlord is always certain that he can never be precluded from obtaining the FULL value for his land, whatever circumstances

may arise. And, if the tenant shall prove disagreeable, so that he would wish rather to put another in his place upon the same terms, it never can be any hardship upon the landlord to pay the stipulated sum; because it would be the same thing to him as if he bought a new estate at TEN years purchase free of taxes; a thing not to be expected. It is indeed true, that it would be more advantageous for him to allow the present tenant to continue; therefore this alternative will be always accepted of, unless in very extraordinary cases, as it ever ought to be; and thus the tenant's mind is impressed with a conviction that he will continue in his possession; a conviction that ought ever to prevail, because it stimulates to industry in the highest degree.

AND as the tenant is thus certain that, at the very worst, his family must be entitled to draw a reasonable remuneration for the exertions of his industry, he can never find the smallest tendency to relax in his endeavours.

BY stipulating in the original lease in the same manner, that, at the end of the second 21 years, the lease shall be continued for 21 years more;

and so on at the end of the third, and fourth, and any farther number of periods of 21 years, on agreeing to pay a specified rise of rent; reserving to each party the same privileges as above described, the lease might be continued to perpetuity, without any hazard of the one party obtaining an undue advantage over the other. The tenant being always certain of having a preference given him over every other person, will of course go on with unceasing exertions to better his land, which of necessity must tend to augment the income of the proprietor much more than could have happened under any other system of management.

SUCH are the outlines of that plan of a lease which his Lordship has proposed. By this plan the tenant's hands are not tied up by restrictive clauses, dictated by ignorance, under the pretext of securing the interest of the landlord. The interest of the landlord is effectually secured, while the tenant is left at full liberty to avail himself of his knowledge, his skill, and his industry. Instead of ceasing to begin any arduous undertaking, as he must ever do where he has no lease, or of improving for a few years only at the com-

mencement of his lease, but stopping in a short while in the midst of his career, and then running the land down to the same exhausted state as it was at its commencement, he continues to push forward without ever stopping; and advances even with an accelerating progress for an endless period of years. No person but an experienced farmer can conceive the difference that would exist between the productiveness of the same land under this management, at the end of a hundred years, from what it would have been if let even for detached periods of twenty-one years each. In unimproved waste lands, the difference would approach almost to infinity. In lands originally very rich, the difference would be less considerable; but, in all places where improvement by cultivation could take place, the difference would be very great.

SECT. II.

On Covenants in Leases, which restrict, and interfere with, the Tenant's Operations.

IN Scotland, where the custom of granting leases is general, the restrictive clauses are few,

being chiefly confined to the latter period of the lease, and seldom, even then, injurious to agriculture. The restrictions on management which then take place, relate to the mode of cropping, to the quantity of land that is to be kept in grass, and, finally, to the dung on the farm, and to the land to be left in fallow in the waygoing year. These may be said to be the only restrictions on the management of the tenantry; and, taking human nature as it is, they are obviously necessary. This is not the case, however, with the restrictive covenants in the majority of English leases. These operate from the outset, and interfere, almost in every case, with the tenant's management. There are numerous exceptions, no doubt; but, in most cases, the slightest discretionary management is not permitted. In fact, the tenant, in many instances, cannot be viewed as a free agent, but as one under the government of a second person, who prescribes his operations, and punishes any neglect or disobedience of which he may be guilty.

It is easy to perceive that such a system must be totally adverse to improvement. In fact, the mind, under its influence, sinks into apathy, and

remains contented with the portion of knowledge already gained, without endeavouring to search after additional information. The common and ordinary operations of a farm may be sufficiently executed by those so circumstanced ; but improvement must be at an end when there is no room for the exertion of ingenuity. The very interference of stewards with a tenant's management is sufficient to deaden his exertions. At all events, their interference crushes his independence, renders him obsequious to those above him, and careless about future improvement.

HERE it may be observed, that the primary error of this system consists in not giving the tenant a security of possession for a reasonable time ; and the second, and no less important error, arises from the restrictions imposed during the time he occupies his farm, which prevents him from changing his management, or adapting his crops to the nature of the soil which he possesses. Agriculture is a living science, which is progressively improving ; consequently, what is esteemed good cropping at one time, may, from experience and observation, be afterwards found defective and erroneous.

WE readily admit, that general rules of management are very proper in leases, such as, to keep land in good order, to consume all the straw raised upon it, and to sell no dung. These restrictions we approve of; and so will every good farmer, whether he is bound to do so or not. Nay, we go farther, and allow that, when leases of a proper duration are granted, it is highly reasonable the property of the landlord should be protected by restricting clauses, for the five years previous to their expiration. But, after all, it will be found that no clause can be inserted, besides the general ones already mentioned, that will serve to enhance the value of the land, except obliging the farmer to leave a proportional quantity of grass land at the expiration of the lease, and specifying the manner in which it is to be sown down. Other clauses serve only to distress the farmer, but will never promote the interest of the landlord.

IN a word, as the landed proprietor can rarely farm his own lands to advantage, it is necessary, when he puts them under the management of others, to invest these persons (generally called tenants) with discretionary powers, or, in other

words, with powers to do every thing respecting their cultivation which he himself could have done without injuring the property, otherwise he cannot expect to receive, under the name of rent, the full natural value of his land. It must be remarked, however, that proprietors, in general cases, consent with reluctance to part with the command and management of their land when conveyed for a temporary period, reserving as much controul over it as possible ; though it is plain that every reservation made lessens the tenant's power to pay them a high rental. This is not the case with the monied man ; he neither understands, nor pretends to understand, the secrets of the trade or manufacture in which his money is invested, and therefore places his confidence in the man, and not in his measures. Why should the landlord act differently ? or why should he affect to direct the whole farming operations of his tenant during the course of a lease ? A resident proprietor, who has paid attention to farming, may attempt such direction without any great degree of absurdity, though never without lessening the sum of rent covenanted to be paid ; but it is ridiculous to see such direction claimed by law-agents, to whom the management of large

estates is chiefly entrusted, and who know little more about farming than the monied man does about the manufacture of muslin or linens. The utility of some restrictions at the conclusion of a lease we have already admitted, chiefly because without them a farm might be thrown out of shape, and the management of the succeeding tenant embarrassed for several years. As for the injury alleged to be committed, by what is called cross cropping, we are rather sceptical on that point; and confess it to be our opinion, that the real value of the soil cannot be lessened by any mode of cropping, though undoubtedly its artificial value, namely, that which it gains from being grazed and manured, may in that way be dissipated. Taking a broad view of the matter, we are inclined to consider restrictive covenants as totally superfluous, unless so far as they tend to maintain a regular course of cropping at the conclusion of the lease, and to preserve the farm in a husbandman-like condition, at the entry of the succeeding tenant.

SECT. III.

On the Rent of Land, or the Considerations given by the Occupier for the Land in his Possession.

IN ancient times, the rent of land consisted in a certain part of the articles which it produced, and in services often unfixed and undetermined. Money in these periods was scarce, markets for the sale of produce irregular, and in many places not to be found ; therefore the scarcity of circulating medium, and the general want of markets, rendered a payment of rent in kind a necessary measure. In proportion, however, as the country increased in prosperity, the necessity of paying rent in this manner was gradually obviated, till at last it was almost quite done away, and a

fixed payment in money substituted in its place. Latterly, an inclination to return to the ancient practice has been manifested by several proprietors ; but whether such a return would be of advantage to agriculture, scarcely requires to be discussed. In fact, a rent, either partially or wholly paid in corn, must necessarily be disadvantageous to the tenant ; because the money value of the payment is always greatest when the means of paying it are lessened or curtailed. The price of grain in Britain is rarely high, unless when adverse seasons intervene, and cause a scarcity of farm produce. When the tenant pays in money, the augmented price compensates to him the deficiency of quantity ; but when in corn, the whole disposeable produce may be insufficient for discharging the contracted obligation ; consequently the tenant may thus be brought under great difficulties.

BESIDES what is properly called rent, several public burdens are borne by the tenant, in virtue of his lease, or by act of the legislature. In Scotland these are not of much importance, being only one half of the schoolmasters salary, one half of poor's-rates, and the com-

muted value of work statuted to be performed on the public roads ; the amount of these is trifling, rarely exceeding two per cent. of the rental. But in England the case is different. There the whole public burdens, to which landed property is subject, are defrayed by the tenant, with the exception of the new property tax, from the landlord's share of which he is expressly relieved. These burdens are, 1. The land tax ; 2. Poor-rates ; 3. Tythes, where not purchased or commuted ; 4. Road work ; 5. Church and constable dues. &c. and often amount to a greater sum than the nominal rent stipulated betwixt the parties, though they are to all intents and purposes a part of the real rent. Most of these burdens being unfixed, and some of them regulated by the mode of management (such as tythes) render the situation of the tenant vexatious and unpleasant. Were all land tythe free ; were the public burdens to which it is liable uniformly defrayed by the proprietor ; were rent to be affixed and determinate sum during the years of possession, and the tenant relieved from all arbitrary claims ; then the art of agriculture would be exercised with pleasure and satisfaction. It is owing to the greater freedom enjoyed by the culti-

vators of Scotland, and to the superiority of the system which connects them with proprietors, that the art has progressively advanced with greater rapidity towards perfection in the one country than in the other. The same principles which have proved so beneficial to Scottish agriculture, must necessarily produce equal advantages, were they acted upon in other places. Physical circumstances are more favourable to agriculture in England than in her sister country, though it is to be lamented that the benefit of these circumstances is more than counteracted by an accumulated quantity of moral evils, which might be removed, were the legislature to bestow on these matters a portion of that attention, which it often bestows upon the melioration or improvement of foreign possessions.

CHAP. V.

ON TILLAGE.

TILLAGE may, in general terms, be described as an operation whereby the soil is either cleared from noxious weeds, or prepared for receiving the seeds of plants cultivated by the husbandman. When this operation is neglected, or even partially executed, the soil becomes foul, barren, and unproductive; hence, upon arable farms, tillage forms the prominent branch of work; and, according to the degree of perfection or imperfection with which it is executed, the crops of

the husbandman, whether of corn or grass, are in a great measure regulated.

TILLAGE, in the early ages, was performed by hand labour; but in modern times, the plough has been the universal instrument used for executing this necessary and important branch of rural work. In no other way can large fields be turned over, because the expence of digging with the spade, the only other method of turning over the ground, would much exceed any profit that could be reaped. Spade-work, however, is almost universally used in garden culture, where the plants raised are of greater value than those cultivated in the fields; though the nearer that field culture can be brought to what is exercised in a garden, so much more may the practice of the one art be considered as approximating in perfection to that of the other.

SECT. I.

Obstructions to Tillage.

IN a work of this kind, it is unnecessary to enlarge upon the way by which tillage may be successfully executed. It is proper to state, however, that stones lying above or below the surface are the most formidable obstruction to perfect tillage. On stony ground, tillage is not only imperfectly executed, but in many cases the implement used is broken to pieces, and a considerable portion of time lost before it is repaired, and put in order. The removal of stones, therefore, especially of such as are below the surface, ought to be a primary object with every agriculturist; because a neglect of this kind may afterwards occasion him considerable loss and inconvenience. In our practice we have ascertained, that rocky fields are ploughed at an expence nearly double of what is required upon others under different circumstances; because the ploughman, from necessity, is obliged to go slowly and with cau-

tion. In such situations the evil hardly admits of correction, because the substratum is almost of the same nature; and the rocks which appear may be considered in the light of excrescences from the substratum; but where single fixed stones appear in an arable field, they ought to be removed immediately, although the closeness of their texture may render the assistance of gunpowder necessary. It deserves attention, that very fine soil is always in contact with rocks of this description; and that by gaining the use of it, much benefit is derived, independent of the facility which is thus afforded to the ploughman's operations.

To drain the ground, in other words, to lay it dry, also facilitates tillage exceedingly; for ploughing cannot be performed with advantage, where either the surface or the subsoil is wet. In fact, every branch of good husbandry is intimately connected with another; and the practice of one branch is necessarily much affected by the way in which others are executed. To drain land well, therefore, materially promotes good tillage; and by good tillage the beneficial effects of manures are considerably increased. To dis-

charge one of these fundamental duties of the husbandman, while the others are neglected, can only be regarded as performing a duty which will yield small benefit to those concerned; but to fulfil the whole duties incumbent on the husbandman, namely, to keep his land dry, clean, and rich, must be estimated as the acme of perfection in the rural art.

SECT. II.

On the Utility of Summer Fallow.

To return to our first definition of tillage, wherein it is characterised as the operation by which the soil is cleaned or rendered free of weeds, we must observe, that the only sure and certain way of accomplishing this object is by ploughing in the summer months, when the ground is dry, and when, by the influence of sun and air, the weeds may be destroyed with facility. Seldom at any other period is the soil

much benefited by ploughing, unless so far as a seed-bed is thus procured for the succeeding crop; and though the situation or state of the ground, when these intermediate ploughings are bestowed, is of importance in judging of their utility, yet the radical process of summer fallow cannot, by any means, be altogether dispensed with. Indeed, if the winter and spring ploughings are executed under favourable circumstances, and plenty of manure is at hand, it may be delayed for a greater number of years than is otherwise practicable, if good husbandry is to be maintained.

IN judging of these things, an extensive practice, in almost every kind of soil, has been our guide; and, though free from prejudice, we are compelled to declare, that without summer fallow, or, which is the same thing, without working the ground in the summer months, perfect husbandry is unattainable on all heavy or cold soils, and upon every variety incumbent on a close or retentive bottom. No doubt a bare or naked fallow is not necessary upon light free soils; because such may be worked in the months of May and June, and afterwards cultivated with

turnips. This exception we have uniformly allowed, but farther we cannot go. Even the potato husbandry on such soils is, to a certain degree, imperfect, as may easily be ascertained by examining land so cultivated, after the crop is taken up.

To keep his land clean will always be a principal object with every good farmer; for, if this is neglected, in place of carrying rich crops of corn or grass, the ground will be exhausted by crops of weeds. Where land is foul, every operation of husbandry must be proportionally non-effective; and even the manures applied will, in a great measure, be lost.

If the season of the year, and the state of the weather, when the ground is ploughed, preparatory to receiving the seed, be duly considered, it will be found, that at that time it can neither be properly divided by the action of the plough, nor can root weeds, or annual weeds, be then extirpated. Hence arises the necessity of working it in summer, when the weather is favourable for the purposes of ploughing, and when root weeds may be dragged to the surface. It is only

at that time the full advantages of ploughing are attainable ; for summer fallow may with propriety be styled ploughing in perfection.

THE necessity of summer fallow depends greatly upon the nature and quality of the soil ; as, upon some soils, a repetition of this practice is less frequently required than upon others. Wherever the soil is incumbent upon clay or till, it is more disposed to get foul, than when incumbent upon a dry gravelly bottom ; besides, wet soils, from being ploughed in winter, contract a stiffness which lessens the pasture of artificial plants, and prevents them from receiving sufficient nourishment. When land of a dry gravelly quality gets foul, it may easily be cleaned without a plain summer fallow ; since crops, such as turnips, &c. may be substituted in its place, which, when drilled at proper intervals, admit of being ploughed as often as necessary ; whereas wet soils, which are naturally unfit for carrying such crops, must be cleaned and brought into good order, by frequent ploughings and harrowings during the summer months.

IT is from neglecting to make these distinctions, that many people have pronounced erroneous opinions concerning summer fallow.

THE substance of the arguments generally used against fallow may be comprised under four heads :

1st, NATURE does not require any pause or rest, and the earth was evidently designed to yield a regular uninterrupted produce.

2dly, As the productive quality of the earth never ceases, if corn is not sown, weeds will be produced ; therefore it is our business to expel the unproductive plant, and to introduce others that are beneficial.

3dly, THAT the idea of leaving land to rest is ridiculous ; for, by keeping it clean, and by a judicious intermixture of crops, it may be managed like a garden, and sown from one generation to another.

4thly, THAT the fallows in England exhibit nothing but a conflict betwixt the farmer and his

weeds, in which the latter generally prevail ; for at the best they are only half stifled, and never effectually killed.

THE most of these arguments may be granted, and yet the utility, nay, the necessity of summer fallow be consistently maintained.

IT is already acknowledged, that it is only upon wet soils, or, in other words, upon land unfit for the turnip husbandry, that a plain summer fallow is necessary ; and this we suppose includes three-fourths of the island. The utility of summer fallow upon such soils is not contended for, because Nature requires a pause to invigorate her to carry fresh crops, but solely because it is impossible to keep them clean without this auxiliary process. To speak of following Nature in farming is ridiculous ; for if we were to imitate Nature, we would not cultivate land at all. Nature is often improved by art, and fallowing is the means employed for removing a host of enemies, which prevent her from being fertile and productive.

As a field filled with root weeds must be in a state of greater exhaustion, than if it carried a heavy crop of corn, so the productive quality of the earth must necessarily decrease in proportion to the quantity of weeds which it brings forth. But because corn is not sown, it does not follow that weeds of any kind should be suffered to grow. The object of allowing the ground to remain a year under fallow, is to afford time and opportunity for expelling the unproductive plants, and to prepare it for the reception of others which are beneficial.

THE most judicious intermixture of crops upon clay soils will not preclude the necessity of summer fallow, although it will go a great way to prevent a frequent repetition of it. An eighth course shift, such as fallow, wheat, beans drilled and horse-hoed, barley, grass-seeds, oats, beans, and wheat, is as much as can be recommended ; and it is only upon rich clay, or deep loam, where such an extensive rotation is admissible. A shift of this kind, when dung is applied twice in the course of it, will pay the farmer more handsomely than the most judicious intermixture of crops, where fallowing is neglected.

AGAIN, no rules drawn from garden practice can apply to operations carried on in the field; the soils are generally very different, and any comparison that can be made, must be with those rich sandy loams, upon which we have allowed fallowing to be unnecessary. The crops in the garden are reaped at so many different times, and often so early in the season, that opportunity is always gained for working the ground in the completest manner; while the immense difference between working with the plough and the spade renders every comparison ridiculous.

A fallow field, which exhibits a conflict betwixt the farmer and his weeds, does not deserve that appellation; for the intention of the fallow is to extirpate these weeds. We are inclined to think, that the miserable situation of many English fallows may be attributed to the feeding, and folding them with sheep. The farmer, from being obliged, by the conditions of his lease, or the rules of common field management, to fallow every third or fourth year, is tempted to draw something from them when in this unproductive state; and, to gratify his avarice in the first instance, sacrifices the good husbandry which

it is his ultimate interest to practise. A well managed fallow should be wrought as early in the season as possible, and continually turned over so long as the least particle of quickens appears. It is no argument against the utility of fallows, that they are often managed in a different way ; this militates only against the impropriety of the management, but not against the practice itself.

UPON the whole, the necessity of summer fallow turns upon this single point :— Can wet lands be advantageously employed in raising turnips or cabbages ? a question which the practical farmer, who is sufficiently acquainted with the nature of such soils, and the immense labour required to bring them into proper tilth, will have no difficulty to answer in the negative. It is not disputed that turnips and cabbages will grow upon these soils ; but the question is, whether the extraordinary labour they require, and the damage sustained by the ground, during the consumption or carrying off the crops, will not exceed the value of the produce ? Surely few persons will recommend the turnip husbandry under such circumstances. If they do, the recom-

mendation furnishes a presumption, that they are unacquainted with the cultivation of wet lands. If they do not, how is the ground to be kept clean, and enabled to yield a regular uninterrupted produce ?

NOTHING that is said in defence of fallow is meant in vindication of the absurd system of taking only two crops to one fallow, as practised upon many English common fields. It is only meant to show, that clay soils, and every soil incumbent upon a wet bottom, cannot be kept clean without the assistance of this radical and ancient practice. How often it should be used, must in a great measure be left to the discretion of the farmer, who will repeat it when necessary, if he knows his own interest.

As many different opinions prevail relative to the manner in which a fallow should be conducted, our sentiments upon that head may be acceptable.

UPON all clay soils (and upon such only, we understand a complete summer fallow to be necessary), the first ploughing ought to be given

during the winter months, or as early in the spring as possible ; which promotes the rotting of the sward and stubble. This should be done by gathering up the ridge, which both lays the ground dry, and rips up the furrows. As soon as seed-time is over, the ridge should be cloven down, preparatory to cross ploughing ; and, after being cross ploughed, should be harrowed and rolled repeatedly, and have every particle of quickens brought above by the harrows carefully picked off with the hand. It is then proper to ridge or gather the field up immediately, which both lays the land in proper condition for meeting bad weather, and opens up any fast land that may have been missed in the furrows when the cross ploughing was given. After this, harrow, roll, and gather the root weeds again ; and continue so doing till the field is perfectly clean.

SOME agriculturists recommend a method of fallowing very different from the above. In their opinion, ploughing is only necessary ; and taking out live roots by the harrow, and carrying them off, is considered by them as an evident impropriety.

HERE it may be remarked, that frequent turning over the ground, although absolutely necessary while the process of fallowing is going on, can never eradicate quickens, couch-grass, or other root weeds. In all clay soils, the ground turns up in lumps, which the severest drought will not penetrate, or at least not so far as to kill the plant contained in the heart of them. When the land is ploughed again, these lumps or clods are simply turned over, and no more; the action of the plough serving in no shape to reduce them, or at least in a very imperceptible manner. We remember a season, considered as one of the best ever known for executing the fallow process by ploughing only, when the truth of these observations was fully ascertained. During that summer there was hardly a drop of rain; the drought was excessive, and attended with an almost continued sunshine; yet, notwithstanding all these advantages, the fallows, which were not properly reduced in the beginning of the season, took on a growth as soon as moisture came, about the beginning of harvest. Even when they were completely harrowed and rolled, it was found difficult to extirpate couch, as the dryness of the

ground did not allow it to part so well from the clod as in seasons more moist.

IF this be the case in a dry season, what would the consequences be if the fallows were at all times to be wrought with the plough, without attempting to drag the roots to the surface by the operation of harrowing? In wet weather, the land might appear black above for a few days; but the enemy being still in the house, would soon make his appearance. By carefully gathering all the root weeds, after the land is reduced by harrowing, which on many soils is only practicable after the roller is used, an enemy is converted into a friend; for if the stuff, thus gathered, is accumulated into a heap, frequently turned over till it rots, and mixed with lime, a most excellent compost is produced.

THERE is little danger that clay land will be too much reduced by the different harrowings and rollings proposed to be given; as the last furrow, if taken sufficiently deep, will raise a mould rough enough for covering the seed, and protecting the wheat during the winter months. Upon such soils, nothing but frost will reduce

and mellow the land perfectly ; and we have seen the necessity of leaving fields of this description to be wrought in the spring, from the absolute impossibility of eradicating or killing the couch completely, till reinforced by this powerful auxiliary.

WE may mention another argument in favour of gathering root weeds :—That in no other way can the purpose for which fallow is intended be so cheaply attained. Every furrow that is given will at least stand the farmer 12s. per acre ; and if hand gathering will save one single ploughing, its expence is amply repaid ; while, at the same time, we contend that more root weeds are taken off by one gathering, than can be destroyed by a couple of ploughings, allowing the season to be ever so favourable.

SOME writers on husbandry condemn clean summer fallow altogether, as an unnecessary waste of rent and labour ; which, in their opinion, might be saved, and the ground kept in perfect good order by a proper rotation of crops. We apprehend upon all clay soils this is impossible ; as every farmer who possesses such soils

knows, by experience, the difficulty of keeping them clean, even with the assistance of summer fallows. They are so often ploughed wet, from necessity, that a sourness and adhesion are contracted, which cannot be corrected without exposing the ground to the hot summer sun, and reducing it by frequent ploughings and harrowings. No crop can be substituted in place of fallow, for turnips are destruction itself. Drilled beans, as is already said, will do well as an assistant to fallow; but however much this crop may tend to *keep* land clean that is already in good order, we apprehend, from the necessity of sowing them early, that they will never answer as a substitute for one of the most radical of all improvements,—a clean summer fallow.

A general introduction of the row or drill husbandry has been proposed as a substitute for summer fallow; and many ingenious reasons have been urged to prove the inutility of the practice, and the folly of those who adhere to it. The author of the *New Farmers Calendar* even goes so far as to maintain, that fallowists can bring forward no arguments but hypothetical ones, in defence of the system which they sup-

port. These matters being of great importance to the cause of agriculture, we cannot refrain from noticing them in a cursory manner.

IN the first place, let any person reflect on the condition of all land incumbent on a retentive subsoil, in an average of years, when spring seeds are sown. Land of this description, which has been ploughed in winter, will, in the spring season, when ploughed a second time, turn up raw and wet, even when the surface is tolerably dry, and in a workable state. The new turned up furrow is tough and waxy in the first instance, but afterwards, especially if a hot sun prevails, the surface becomes hard like a brick, even before the bottom or subsoil is free of the superabundant moisture there accumulated. Under these circumstances the processes of drilling cannot be executed upon clay soils with the slightest prospect of advantage. It is even difficult to form drills for beans in many seasons, though this grain is generally drilled at wide intervals. To drill wheat, barley, or oats, upon clay soils, in the spring months, may be regarded as a measure physically impossible. Such grains must necessarily be drilled with narrow intervals, say nine

or twelve inches ; and though this is practicable on light soils during dry weather, it cannot, with the slightest prospect of success, be executed upon those of a different description. The correctness or justice of these arguments will not be questioned by any person versant in the culture of heavy lands, or by those who have paid attention to the difficulties of performing seed-work upon them in the majority of seasons.

IN the second place, were we to allow, for argument's sake, that the drilling of grain was a practicable measure upon wet lands, still it remains to be inquired, how such soils can be cleaned in a satisfactory manner, when the intervals betwixt the drills must necessarily be narrow and confined, admitting little more than a narrow hand hoe, which never can extirpate root weeds, or free the ground of its aboriginal inhabitants. Were a horse hoe to be used, the surface would break up in lumps, or massy pieces, to the destruction of the grain plants, whilst, after all, a hoeing of a deepness sufficient to destroy the weeds could not be given. If the intervals were wide enough to allow a horse hoe room for work, the produce of the crop would be proportionally curtailed, while the quality of the grain would be

materially injured from a continuance of tillering, till a very late period. With beans this does not happen ; for, the pods being placed upon the under and middle parts of the stalk, the introduction of air is absolutely necessary to increase their number, and to bring the grain to maturity. Wheat, barley, and oats, are differently circumstanced: With them the grain is placed upon the top of the stalk, consequently the introduction of air is less necessary. At all events, we are confident that, with equal management, a greater produce may be gained from culmiferous crops upon *clay* soils, according to the old husbandry, than can possibly be gained by the introduction of row culture. That the southern districts of England, and many kindly soils in other districts, may be drilled with safety and advantage, we do not mean to dispute ; but betwixt these and the generality of soils which prevail in the island of Britain, a distinction must be drawn, the husbandry eligible for the one being inadmissible for the other.

IN the third place, what is summer fallowing but merely tilling the ground at a proper season, and freeing it from weeds, at a time when the

operations of ploughing and harrowing can only be successfully executed? If we had no wet weather, and no winter months, then constant cropping would certainly be practicable, and an extra stock of men and horses would be all that was required; but in the present state of British climate (and we know not how it is to be amended) little or no work can be done from autumn to the first of April, which can materially tend to clear the ground of root weeds. The sole object of ploughing in winter is to rot the stubble, and prepare a bed for spring seeds. Even with every degree of attention, ploughing is often, from necessity, performed in the winter season under such unfavourable circumstances, as to hasten a return of summer fallow sooner than could be wished. The anti-fallowists allege, "that the earth is destined by nature to an everlasting round of vegetation;" but there is not much sense in the position when applied to practical husbandry. Will the earth ever produce crops unless the seed is sown? or ought corn to be sown unless the earth is properly prepared for its reception? The spontaneous productions of the earth being assuredly very different from what man wishes, his constant object is to des-

stroy them, and substitute artificial ones in their place. In a word, to free the earth from the articles which it naturally produces, ought to be, and is the steady object of every good husbandman ; and the sole subject of dispute is, how and in what way that freedom can be most substantially and effectually gained. Upon all clay soils, and, generally speaking, upon soils of every description, incumbent upon a wet bottom, the best time of cleaning them is in the summer months ; and in this opinion we are decidedly supported by the respectable author of the Staffordshire Survey. That gentleman, in his report to the Board of Agriculture, says, “ Fallowing for wheat on cold, wet, or strong lands, and on all such as are unfit for turnips, is absolutely necessary ; and he who attempts to manage such land without fallowing, will have occasion to repent his mistake. Mixed soils, which are too moist for turnips, have a particular propensity to the production of root grasses. Summer fallow, therefore, becomes absolutely necessary ; and every attempt to crop without it, for any length of time, on such land, has terminated to the injury of the land, and the loss of the occupier.”

BEFORE we leave the subject of summer fallow, it may be remarked, that the ancients seem to have been very sensible of its utility ; for, instead of recommending to fallow at periods, three, four, six, or eight years from each other, as is commonly done by modern writers, they mention it as a necessary preparation for a crop in ordinary soils. In Switzerland, and some parts of France, they crop and fallow alternately ; and this seems to have been the common practice among the Romans, from whom, no doubt, other nations received it. If the Romans, who enjoyed, from the early season of harvest, great advantages over us, fallowed so frequently ; if they seldom had a crop of any kind immediately after a crop of wheat and barley ; if they even seldom sowed these grains upon lands that had carried a crop in the preceding year, excepting when such was cut green for cattle, certainly the late season of harvest in Britain, and the difficulty of preparing land after it for winter grain, should engage us to fallow much more frequently than we do.

ALTHOUGH agriculture, and other arts, may have now arrived at greater perfection than un-

der the Roman government, we believe much benefit may still be gained from a studious examination of the Roman agricultural system. Good ploughing seems to have been an object of their particular attention ; and with respect to industry in collecting and preparing manure, the most assiduous British husbandman falls far short of the ancient cultivators. If the ancients were inferior in theoretical knowledge to our modern improvers, yet, in attention to circumstances, and exactness of execution, they seem to have been greatly superior. Nor will this superiority excite surprise, when it is recollected that the greatest and wisest men among the Romans applied themselves to the study and practice of agriculture. In the hands of such persons, agriculture was brought to the greatest perfection, and all its operations were performed with the greatest economy and exactness. Pliny assigns this as the reason that, in ancient times, there was such plenty of corn in Rome.—“ What,” says he, “ was the cause of this fruitfulness ? Was it because, in those times, the lands were cultivated by the hands even of generals ; the earth, as it is natural to suppose, delighting to be ploughed with a share adorned with laurels, and by a plough-

man who had been honoured with a triumph? or was it because these men ploughed their fields with the same diligence that they pitched their camps, and secured their corn with the same care that they formed their armies for battle?"

THOUGH we entertain a favourable opinion of the rural economy of the Romans, and believe, that much may be learned from it, we are far from recommending it as a pattern to be imitated by British husbandmen. We view it, however, as a ground-work, on which a good fabric may be reared; because the fundamental principles of agriculture were carried into practice by that people, with a degree of diligence and method well worthy of general imitation. Agriculture is a living science, and susceptible of improvement in every age. In our times, when the implements of husbandry are more perfectly formed, and when more suitable modes of cropping, than those used by the ancients, are adopted, it is altogether unnecessary to crop and fallow alternately; because it is completely ascertained, that, by diligent cultivation given to intermediate crops, summer fallow may be delayed for four, six, or eight years, according to soil, seasons,

and other circumstances. But, though from these considerations it appears abundantly evident, that a repetition of fallow so often, as recommended by the Roman writers, is unnecessary under our improved mode of cropping ; yet it does not hence follow, that the practice of working land in the summer months, in other words, of fallowing it, should be given up, merely because the necessity of repeating it so frequently, which formerly existed, is now superseded by superior management. Every argument in support of fallowing, where the land is foul, remains in full force, or on its original footing, although there may not be the same necessity for repeating it so frequently, as was customary in former times.

THE Rev. Mr Dickson, late of Wittingham, the best practical writer on husbandry since the days of Walter Blythe, seems to hold similar sentiments with those we are now maintaining. In his *Husbandry of the Ancients*, a work which displays great genius and acquaintance with the present and former state of rural affairs, after stating the predilection of the Romans for summer fallow, and describing the various ways in which it was executed, he says : “ I am sensible,

that the practice here insisted upon and recommended, in imitation of the ancients, is not agreeable to the most fashionable modes of husbandry. Our latest improvers, or rather our latest writers on agriculture, declare, that he is a slothful or ignorant farmer, who does not raise upon his fields at least one crop every year. When land is very rich, and the farmer remarkably skilful and attentive, and has it in his power, by a command of hands, to introduce the garden culture into his corn fields, it is possible that the schemes proposed by these gentlemen may be prosecuted with success. But, taking our farmers and land as they are in fact, and considering how much weeds still prevail in our fields, and how difficult it is, even for the most attentive farmers, to prevent their crops being hurt by them, frequent fallowing, as the most proper method of destroying these enemies, cannot as yet be too much recommended. When we have arrived at greater perfection in the several operations of agriculture, and brought our lands to a higher degree of fertility than at present, then, and indeed, in my opinion, not till then, should we think of introducing schemes of perpetual cropping." Much, however, as Britain is im-

proved, still improvement is not so forward as to sanction any scheme of perpetual cropping ; and, were it more advanced, we question whether, in such a variable climate as that of the British isles, perpetual cropping can ever be successfully exercised.

A mode of executing summer fallow, and procuring a crop of turnips in the same year, comes now to be noticed. In this way, the land may be completely cleaned, perhaps more so than by bare fallow ; but it is only on light dry soils that such a mode of cleaning is eligible, or can be executed with advantage. The culture of turnips will be noticed in a more particular manner when we treat of leguminous crops.

THE second object of tillage is to prepare the ground for receiving the seeds of plants cultivated by the husbandman ; and here, in general, it may be remarked, that the object is most completely accomplished when the ground is ploughed deep and equal, while the bottom of the furrow immediately above the subsoil is perfectly loosened, and turned equally over with the part which constitutes the surface. In many places

these properties are altogether neglected, the ground being ploughed in a shallow way while the bottom of the ploughed land remains something like the teeth of a saw, having the under part of the furrow untouched, and consequently not removed by the action of the plough. Where such things are suffered, the object of tillage is only partially gained. The food of plants (whatever it may be,) can only be imperfectly procured by such management ; and the ground is drenched and injured by wetness, the bridges, or pieces of land, which are not cut, preventing a descent of the moisture from above to the open furrows left for carrying it off. Again, where the seed-bed is prepared by one ploughing, the greatest care ought to be used in having it closely and equally performed. When two are given, they should be in opposite directions, so that any firm land left in the first may be cut up in the second ploughing. It is not profitable to plough twice one way, if it can be safely avoided.

ANOTHER important point towards procuring good tillage, is never to plough the land when in a wet state ; because encouragement is thus given to the growth of weeds, while a sourness and

adhesion is communicated to the ground, rarely got the better of till summer fallow is repeated. The Roman writers are very particular against ploughing land when wet. It is reprobated, in fact, by every one of them. Columella justly represents wet ploughing as most dangerous to the ground: "When we plough," says he, "we must not touch wet land; for the fields which are ploughed wet cannot be touched for the whole year, and are fit neither for being sown, harrowed, nor planted." Palladius gives a similar caution, and takes notice of the same bad consequences: "It ought to be observed," says he, "that land ought not to be ploughed when wet; for land, which receives the first ploughing when wet, cannot be touched for a whole season." From this passage, it appears that it was reckoned particularly dangerous to give the fallow the first ploughing when in a wet state; and that, when this was done, it was impossible, by any operations afterwards, to bring it to a right tilth that seed-time. Pliny does no more than mention the received maxim: "Do not," says he, "touch wet land."

BEFORE we finish this chapter, it is proper to remark, that all soils ought not to be wrought or ploughed in one manner. Each kind has its particular and appropriate qualities ; and, therefore, each requires a particular and appropriate mode of tillage. Ploughing, which is the capital operation of husbandry, ought, on these accounts, to be administered according to the nature of the soil which is to be operated upon, and not executed agreeably to one fixed and determined principle. On strong clays and loams, and on rich gravels and deep sands, the plough ought to go as deep as the cattle are able to work it ; whereas, on thin clays and barren sands, the benefit of deep ploughing is very questionable, especially when incumbent on a till-bottom, or where the subsoil is of a yellow ochrey nature ; such, when turned up, being little better than poison to the surface, unless highly impregnated with alluvial compost, the effect of which expels the poisonous substance contained in this kind of subsoil, and gives a fertility to the whole mass, more decisive and permanent than would follow a heavy application of the best rotten dung.

ON clay soils, where the ridges must be considerably acclivated, so that the ground may be preserved in something like a dry condition, the plough used for tillage ought to have a mould-board considerably wider set than is required for light soils, in order that the furrow may be close cut below, and duly turned over. This method of constructing the plough necessarily makes a heavier draught than would be the case were the mould-board placed differently; though, if good and sufficient work be wanted, the necessity of constructing the implement in the way mentioned is absolute and indispensable. The plough to be used on light soils, or on all soils that admit what is technically called crown and furrow ploughing, may be made much straiter below, and yet be capable of executing the work in a perfect manner. Perhaps on every farm consisting of mixed soils, two sets of ploughs ought to be kept, otherwise proper work cannot be performed. All land ought to be ploughed with a *shoulder*, a phrase well understood by ploughmen, though not easily explained; and the advantages of ploughing in this way are, that, if ploughed before winter, the surface is enabled to resist the winter rains, and afterwards to present

a face, on which the harrows can make a proper impression when the seed process is to be executed. This deserves particular attention when old grass fields are broken up; as, by neglecting it, the harrows often are unable to cover the seed. It is perfectly practicable to plough land with a tolerably broad furrow, say ten, eleven, or twelve inches, and yet to plough it clean, provided the implement used is properly constructed; but, then, care must be taken that the furrow be of proportional deepness, otherwise it will be laid on its back, instead of being deposited at an angle proper for undergoing the harrowing process.

CHAP. VI.

ON THE IMPLEMENTS OF HUSBANDRY.

No country in the world is better provided with implements for executing rural labour than Great Britain; and to this superiority may, in some measure, be attributed the increased and increasing perfection of its agriculture. We have ploughs of all the different kinds that ever were constructed; and, as for wheel carriages, the variety is immense; whilst harrows, and other common implements, of various constructions and dimensions, are equally numerous. But it is in the articles more properly allied to machinery that the superiority of British rural implements is most conspicuous. Drills, for sowing grain and

small seeds with regularity, have been constructed upon scientific principles; and machines, for separating grain from straw, have been invented, and brought to a degree of perfection expected by few people when these machines were first introduced.

IMPERFECT labour is a necessary consequence of defective implements; but, where attention is bestowed in constructing implements, the different processes of labour, in which they are employed, may, with justice, be considered as perfectly executed, or at least as executed in a better manner, than in those places where attention to their construction is neglected and overlooked. In former times, the construction of rural implements was left almost entirely to rude and ignorant artizans, whose operations were guided by no fixed principle, and with whom improvement was left out of sight, the beaten path being only followed. To those who remember the ploughs that were used in Scotland, at a period not more distant than thirty years from the present date, or who have viewed many of the implements still used in England for tilling the ground, the justice of the above remark will appear unquestionable. At this

time, however, the remark does not generally apply; for the true principles, on which ploughs and other implements should be constructed, have recently been ascertained with mathematical precision, whilst common artizans have been enabled to imitate what they had not abilities to invent. The assistance thus furnished to the husbandman has been considerable; whilst great benefit has flowed to the public, and in particular to the proprietors of land in Great Britain. The husbandman, in the first place, is enabled to execute every branch of work in a more perfect manner, thereby causing the sod to produce greater crops; and, in the second place, proprietors and the public receive equal benefit; the proprietor by an immense increase of his rent-roll, and the public by an increased supply of the necessaries of life, without which neither manufactures nor commerce could continue to be carried on so extensively as they have been for many years past.

SECT. I.

Of the Plough.

THE plough is of such importance in agriculture, that, in all ages, it has held the first place among the implements of that art; nor is there any nation mentioned in history that has attempted to cultivate the ground without it, excepting some barbarians destitute of every art and science. Even these have used something equivalent; some turning up the ground with the horns of oxen, and some with other things equally unfit for the purpose. These rude and barbarous attempts only show the great usefulness of the instrument proposed to be treated of.

IN modern times, many kinds of ploughs have been used for performing the operation of tilling the ground, the construction of each being in some respects analogous to the kind of husbandry practised, and to the extent of mechanical knowledge possessed by the artizan. It appears

that, in ancient times, the plough was considered in this country as a rude instrument, requiring little art in the construction, and unworthy of philosophical attention. It was judged that any thing would do for executing such a clumsy operation as turning over the ground, and that little nicety was required to form an implement which which was to be guided and directed by ignorant peasants. Under these impressions, this useful utensil was, for many centuries, made at random, and without the slightest attention to principles, as is evident from the difference of impelling power called for when different ploughs were employed. The kind of work performed was equally diversified. In many cases, the furrow was imperfectly turned over, or laid up; and in others the under part of the slice was balked, or raftered, in such a manner as to deprive the seeds that were sown of their necessary nourishment. The expence of working defective implements was also an evil of magnitude; it being now sufficiently ascertained, that the improved ploughs may be wrought at one half of the cost which attended the barbarous and cumbrous implements of former times.

THE Roman people were excellent farmers, and, of course, attentive to the construction of ploughs; but after the northern nations overran and subjugated Europe, we do not find that any improvement was attempted upon husbandry implements till the seventeenth century, when Blythe and others took the subject under consideration. In one of Blythe's pieces of improvement, he discovers much knowledge of the several ploughs then used in England; and demonstrates, in a forcible manner, the best way of making a plough, so that the implement may be easily drawn; while the ground is sufficiently worked. By that accurate agriculturist, a correct and minute account of the double plough then used is also given. Many of our readers will remember, that Lord Somerville, some years ago, attempted to bring the double plough into fashion; but few of them perhaps know, that such an implement was well known 150 years before his lordship recommended it. We mention these circumstances, not with the view of recommending double ploughs, but entirely to shew the knowledge which Blythe possessed of the subject. A double plough can hardly, in any respect, be equal to two swing ploughs of the improved

kind, and in many situations must be vastly inferior, especially upon clay soils, where the ground is wet, and the ridges acclivated. Upon soft dry lands, a double plough may be employed without loss, though without any benefit to those who use it, if the comparison is made with well-constructed swing ploughs. A great variety of ploughs are used in England, many of them confessedly of the same construction with those employed for centuries past, and generally worked to the immense loss and disadvantage of those who persist in the use of such implements. The Rotherham plough was the first deviation from the practice of ancient times, being a neat, handy implement, easily worked, and well calculated for tilling almost every kind of soil; though still capable of being much improved, as will afterwards be noticed. This plough is used in most of the English northern counties; and from being generally called the Dutch plough, we are led to believe must originally have been imported from Holland. It was first constructed in Yorkshire, by Mr Joseph Foljambe of Eastwood, in the West Riding, who, in 1720, obtained a patent for the invention, which he afterwards sold to Mr Staniforth of Firbeck. This gentleman for some years

gave liberty to farmers to construct ploughs, upon paying him 2s. 6d. for each ; but afterwards attempting to raise the premium to 7s. or 7s. 6d. the validity of the patent was combated, and set aside, on the ground of its not being for a new invention, but only for a plough improved.

THE dimensions and construction of this plough will appear sufficiently evident from the following description, and from Fig. 1.



Dimensions of the Rotherham Plough.

	Ft.	Inch.	
From the end of stilt <i>Bb</i> , to point of the share <i>G</i> - - - -	7	4	} whole length.
From the end of beam <i>Aa</i> , to ditto of ditto <i>G</i> - - - -	3	0	
Length of the beam <i>AA</i> - -	6	0	

	Ft.	Inch.	
Width of the head in the widest part			} bottom working surface.
D - - - - -	1	4	
Ditto of ditto at E - - - - -	0	9	
Ditto of share behind the wing at <i>f</i>	0	$3\frac{1}{2}$	
Length of surface on which the plough touches the ground EG - - - - -	2	$10\frac{1}{2}$	
Height from ground to top of beam where coulter goes through - - - - -	1	8	
Width between stilts at the end BB	2	6	
Height of ditto from the ground	1	11	
Weight of wood and iron work, about	$1\frac{1}{4}$ cwt.		

FROM this description, it will appear, that the Rotherham plough differs greatly from the old common ploughs; being more slightly and neatly constructed, and having the coulter and share formed and placed so as to raise, and then gradually turn over, the new cut furrow much cleaner, and with less resistance than the others. It is not only capable of being worked with two horses abreast, as is common in most counties where it is used, but does the work in a much superior way than when three or more horses are yoked in a line, a custom too prevalent still in England. The faults of this plough are owing more to the manner in which it is wrought,

than to the principles on which it is constructed ; for, where the horses are yoked in a line, it is necessary to turn the beam considerably to the furrow, in order to give the plough what is technically called land. Owing to this erroneous way of placing the beam, the horses draw in a contrary direction to the share and coulter, which makes the plough go unsteady ; and from the difference betwixt the direction of the draught, and the head on which the share is fixed, the force of the resistance must necessarily be increased, and the work imperfectly performed.

NOTWITHSTANDING the necessity of turning the beam towards the furrow is solely owing to the custom of yoking horses in a line (a custom very prevalent in England), it may be observed, that, when horses are yoked abreast, the ploughs have all more or less of the same direction. The sock or share of the Rotherham plough is indeed much broader in the point than is necessary, which makes these ploughs difficult to work on gravelly soils, and even in clay, when the ground is dry.

THE practice of yoking horses in a line, is truly absurd. Horses never work so easy, or

so equal, as when yoked abreast, or in pairs, nor will the work be done well in any other manner; if the ground is in such a situation as not to bear a horse on the unploughed part, it is unfit for labouring, and ought not to be touched. But this cannot be sustained as a reason for such a practice, it being customary in many parts of England to employ three horses in a line, sometimes even four or five, to plough tender clover leys. The plea of custom and prejudice is well known, and can alone be assigned for such an absurd and unprofitable practice.

WE are clearly of opinion, that every part of plough-work may be executed by two good horses, if they are properly maintained. There is no question but where land is hard and strong, so much work cannot be done in a given time as upon soft and light soils. But this argument has the same weight whatever number of horses are yoked: All we contend for is, that two good horses yoked abreast, in a plough properly constructed, are able to plough any ground when it is in a proper situation for being wrought.

THE Rotherham plough was introduced into Scotland so early as 1730, by a Mr Lomax, or Lummis, who was patronized by the Society of Scotch Improvers, and was afterwards constructed by a Mr Dalziel, near New Liston, in West Lothian; this person being sent, by the great John Earl of Stair, to England, where he was taught, at his lordship's expence, the best and most improved method of constructing ploughs, and other husbandry implements. From a plate and explanation annexed to Maxwell's Collections, it appears, in the clearest manner, that the plough introduced by Mr Lummis was exactly similar to the one used in Yorkshire at this time, usually called the Rotherham plough, a description of which is already given.

WE have been somewhat particular in our account of the Rotherham plough, because its construction was the first attempt to depart from the ancient system of working the soil, at a heavy expence, with large and cumbrous implements. But though the Rotherham plough was brought to Scotland only ten years posterior to the date of Mr Foljambe's patent in England, yet the use of it was adopted by very few people, till 1764,

when it underwent several alterations, and gradually came into general practice. The first alterations were not of much importance; in fact, the chief one consisted in using a chain, which at the best answered no purpose but to strengthen the beam at a place where it seldom was damaged. The head, and every part of the implement, except the chain, muzzle, sock, and coulter, were of wood, with the addition of a covering of thin plated iron upon the mould-board, to prevent it from wearing. The mould-board, from being straight, gradually assumed a curved figure, till finally that important member of the implement was made of cast metal, prepared at foundries upon principles which, from practice, may be pronounced correctly adjusted. The head, which was formerly constructed of wood, and constantly needing repair, is now also made of iron; hence the share, or sock, is kept steadily fixed when at work, which was not the case when wooden heads were used.

THESE improvements were chiefly devised, and, in the first instance, executed by Mr JAMES SMALL, a person to whom the agricultural interest of the country is under great obligations; he be-

ing, with the exceptions of Messrs Lummis and Dalziel, the first artizan who attempted to improve ploughs in Scotland upon mathematical principles. The sock, or share, is made with a fin, or feather, whereby the firm earth at the bottom of the furrow is cut more completely than practicable by the sock of the old ploughs, which acted more in the way of mining and forcing, than cutting and removing the earth with facility or ease; and the mould-board being of cast metal, may be set wider or closer according to the nature of the soil on which the plough is to be used, or the height of the ridges that are to be ploughed. This implement is, therefore, the best constructed swing plough in the island; and with it a man and two horses will, with all ease, plough an English acre per day, except in particular seasons, when the soil from drought has become hard and obstinate. We have often seen a Scotch acre (one fourth larger than English measure) ploughed in two journies, or nine hours work; but this was either when the land was seed furrowed, or with a soil of a loose and friable nature.

THE late Lord Kames, in his *Gentleman Farmer*, says, “ I boldly recommend a plough introduced into Scotland about twelve years ago, by James Small, which is now in great request. This plough may be considered as a capital improvement.” Had his lordship lived a few years longer, and noticed the improvement since made on this valuable and useful implement, he would, with greater justice, have been warranted to recommend Mr Small’s plough in the warmest manner. In short, no kind of plough will cut the furrow so clean, or turn it so nicely over for receiving benefit from the atmosphere, and effect from the harrowing process; and, what is of greater importance, none is more easily drawn, taking into account the quality of work that is performed, than the one of which we are now speaking. A great deal of its utility is determined by the strength of the animals employed in the draught; by the dexterity of the man to whom the management is committed; and by the order and condition in which the coulter and share are preserved: For the best constructed implement will make bad work, when strength and dexterity are wanting in the operators. But, under a parity of circumstances, it may be affirmed,

that the swing plough, brought into practice, and afterwards improved by Mr Small, is fitted for executing work to better purpose than any other of the numerous varieties of that implement employed in the several districts in Great Britain. Fig. 2. represents this implement as used with a chain; though this appendage is now generally laid aside.

THE mould-board, as well as the *sheath*, or head, is now generally made of cast-iron, on the inside of which is an inscription, bearing Mr Small's name, the name of the founders, (Cooper and Barker), and, what is principally intended,—the approbation of the Dalkeith Farming Society. It is now universally used over Scotland, and, perhaps, were it better known in England, the complicated ploughs, with wheels and other trumpery, with which agriculture there is at present encumbered, would at once be displaced. This plough is not apt to be put out of order, being simple in the construction, and effective in operation, is therefore adapted to almost every situation. The chain, connected with the muzzle, by which it is drawn, fixed as far back as the coulter, is not essential to its formation, serving merely to

strengthen the beam, which may be made stronger of itself at less expence, while the tillage is as accurately performed with ploughs that have none. The price is from 60s. to 70s.

THE ingenious Mr Bailey of Chillingham in Northumberland, who has written an essay on the construction of the plough, deduced from mathematical principles and experiments, has furnished a good deal of sound information concerning this valuable implement. When Mr Bailey first endeavoured to ascertain the best form of a mould board, he began with trying to find the form of an inclined plane which would raise any sod from a horizontal position at C to a perpendicular one at D (Vide Fig. 3.); but it soon appeared that, though this might be done for a small slice, yet it would not do for the whole sod, which being bound together at the surface by fibrous roots of different textures, created an elasticity that affected the whole from C to E; and that, if a sod of this description was turned over and left by the plough in a horizontal position as at C, and at an angle of 45 as at E, the inner edge would form a curve, which the mould-board

ought to fit, so as to be pressed equally alike from one end to the other.

It being generally allowed that, in plowing, the greater quantity of surface exposed to the influence of the atmosphere the better ; to obtain this, it is required to find at what angle the furrow sods should be laid.

SUPPOSE AEF and BCG (Fig. 4.) to be two furrow sods of equal dimensions,

Then, because $AC + CE = CE + EG$

By deducting CE, we have $AC = EG$

and $CB = EF$

Hence $AC + CB = EG + EF$ the surface exposed, which is required to be a maximum.

PRODUCE BC, and make $CD = CA$, and draw AD, then $BC + AC = BD$, and the angle DCA being a right angle, and $DC = AC$, the angles ADC and DAC will be each equal to 45 degrees.

THEN the sine of ADC : AB :: sine of DAB : DB. But the angle at D and AB being both constant, DB will be a maximum,—when the

sine of the angle DAB is a maximum, which it is well known to be, when a right angle, or 90 degrees.

BUT as the angle DAC is 45 degrees, therefore CAB will be 45 degrees likewise.

IN order to obtain this, Mr Bailey had several sods cut, of different textures, 9 inches broad by 6 deep, and put into the position shewn by Fig. 5. and measuring at equidistant places the perpendicular heights raised, and horizontal distances removed, from the original position, the result was as in the following table.

TABLE I.

From A to C	Perpendiculars.	Horizontals.
<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
0	0,00	,00
3	0,10	,00
6	0,30	,00
9	0,60	,00
12	1,30	,10
15	2,10	0,27
18	3,20	0 58
21	4,35	1,10
24	5 65	2,00
27	6,95	3,25
30	8,10	5,00
33	8,77	6,90
36	9,50	9,00
39	10,20	11,00
42	10,60	12,80
45	10,80	14,40
48	10,80	15,80
51	10,50	17,00
54	10,30	18,00

FROM the above data a mould-board was constructed in the following manner :

DRAW a right line AC (Fig. 6.), upon which set off, from C to A, the number of equidistant parts of 3 inches each in column first of the above table, and mark them 3, 6, 9, 12, 15, 18, &c.

THROUGH each of these equidistant points draw lines at right angles to AC.

UPON these perpendiculars, on the upper side of AC, set the distances in column 2d of the above table, viz. at

3 inches 0,1
 6 ——— 0,3
 9 ——— 0,6
 12 ——— 1,3, &c.

And through the different points draw the line CDE, which will be the form of the curve that the sod describes in its perpendicular ascent, or the form of the perpendicular inclined planes that assist in raising the sod from a horizontal to a perpendicular position.

UPON the perpendiculars, on the under side of the line AC, set the distances in column 3d, viz. at

12 inches 0,10
 15 ——— 0,27
 18 ——— 0,58
 21 ——— 1,10
 24 ——— 2,0, &c.

And through the various points draw the line CFG, which will be the form of the curve that the sod describes in a horizontal position, or the form of the horizontal inclined planes that assist in turning the side over.

THE sod being perpendicular at B, and also the mould board, the point D will be at the same distance from the land side of the plough, as the width of the sole BF.

THEREFORE a line drawn from F through *c*, to meet the line AC in *d*, will, with BF and Bd, represent a section of the plough through *cd*, parallel to the horizon at 8,77 inches high

AND a line from F through *e*, to meet AC in *f*, gives the triangle BF*f*; which will represent a section of the body of the plough through *ef*, parallel to the horizon at 8,1 inches high.

AND lines from F, through *g, i, l, n, p, r, t,* &c. to intersect AC in *b, k, m, o, q, s, u,* &c. will form triangles representing sections of the body of the plough, through *gb, ik, lm, no, pq, rs, tu, vv,* respectively.

THEN make $cd = Bd$

$ef = Bf$

$ik = Bk$

$lm = Bm$

$no = Bo$

$pq = Bq$

$rs = Bs$

$tu = Bu$

$vw = Bw$

AND through the points $C, w, u, s, q, o, m, k, b, f, d$, draw the curve Cmd , which, continued to I , will be the true form of the breast of the plough.

THE result of this construction gave the curve of the breast as in Fig. 5. the form of which may be gotten for practical purposes by erecting perpendiculars on BC at convenient distances, and their height being measured is as in the following Table.

TABLE II.

Distance from C.	Height of Per- pendiculars.
<i>Inches.</i>	<i>Inches.</i>
3	0,10
6	0,32
9	0,73
12	1,36
14	1,98
15	2,30
16	2,70
17	3,12
18	3,72
19	4,30
20	5,05
21	6,00
22	7,15
23	8,55
24	10,10
25	12,00
26	14,50

THE form of the inclined plane up which the sod is raised, is represented upon the mould board by the dotted-line CDE.

THE real principle by which the sod is elevated being that of inclined planes, is subject to calcu-

lation. The power necessary to raise any given weight up an inclined plane being as the height of the plane is to its length; this affords a means of judging of the comparative merits of mould boards, as the line of ascent is easily deducible from the form of the mould board.

FOR instance, if the form of the mould board be such that a part of the sod fifteen inches from the sock point is raised four inches in perpendicular height; this being compared with Table I. it will be found that, at the same distance, the perpendicular height was only 2,1 inches; and of course, by the properties of inclined planes, the power required in the first case would be nearly double to that required in the latter.

HAVING obtained the form of the mould board and that of the breast, the next thing to be determined was the height of the beam, so as there might be as little loss of power in the draught of the horses as possible. This was demonstrated by Mr Bailey to be, when the point at the horse's shoulder, the point of yoking at the beam end, and the obstacle to be overcome,

were in *one right line* ; also that the middle of the beam should be in the same plane as the land-side of the plough. Vid. Fig. 7. Plate III.

If a bended lever CBD moving on the fulcrum C, be acted upon by a power at the end D, in direction of DP ; to find the direction of DP, so that the point D may remain in equilibrio.

By the resolution of forces, DP will be resolved into PQ and DQ ; PQ being that part of the absolute force which tends to *raise* the end D ; —and DQ is that part which tends to turn the lever round C, and *lower* the end D ; which, by the properties of the lever, is as CA.

THEREFORE the force to raise the end D, being PQ, and the force to lower the end D, being CA, it can only be in equilibrio when these two forces are equal.

To find this : Produce PD to E ; then the triangles DPQ and DAE being similar, DE will represent the absolute power, and AE represent PQ, or that part which tends to raise the end D ;

but that AE may be equal to AC, the point E must descend and coincide with C, in which case the position of EDP is changed to that of CDP, and the point of draught P, the point of yoking D, and point of resistance, will be in one right line.

THESE principles being established, the rules for *determining the position and dimensions of the most essential parts of a plough*, are not difficult to be comprehended.

THAT the operation of ploughing may be performed with the least loss of power, it is necessary to know the height and inclination of the horses shoulder.

WHILE a horse is in the act of pulling, the inclination of his shoulder varies from 69 to 75 degrees, according to circumstances; the medium is 72 degrees; and the medium height of the point of draught on the shoulder of a horse, $15\frac{1}{2}$ hands high, is 48 inches.

THESE data being got from experiment, and the depth to be ploughed (suppose 6 inches) given,

DRAW a right line AB, Fig. 8. and at any point A, erect a perpendicular AP, equal to 48 inches.

MAKE the angle APB = 72 degrees, and produce the line bounding this angle to meet AB.

SET the length of the traces and swinging trees from P to H; this is commonly 102 inches.

FROM H, upon AB, let fall a perpendicular HI, which, measured on the scale that AP was taken from, will give the height of the beam.

THEN at the distance of half the depth the land is intended to be ploughed, draw a line parallel to AB, and from C, where it intersects PB, let fall a perpendicular upon AB to S, which will give the point of the sock; and a line drawn through C, making an angle of 45 degrees with BA, will be the position of the fore-edge of the coulter.

THE heel of the plough will be got by setting the length of the sole 36 inches from S to L.

THE length of the beam may be determined by erecting a perpendicular at L, which will give the length of the beam MH.

THE form of the breast or sheath SG, will be obtained from Table II.

As many people entertain an idea, that the position in which the furrow sods are laid depends on the form of the mould-board, the following propositions may shew that this is not the case, but that the position depends on the proportion between the breadth and depth of the furrow.

I.

HAVING given the breadth of the furrow (nine inches and depth seven) to find the angle of position, at which the sod will be laid.

DESCRIBE, as in FIG. 9, a semicircle on the breadth AB, and with the depth BC intersect the semicircle in C, through C draw AD, and measure the angle DAB, gives the angle of position 51 degrees nearly.

By calculation, as $AB : \text{Radius} :: CB : \text{the sine of the angle } CAB, \text{ or } 51^\circ 3.$

II.

HAVING given the angle of position (30°) and breadth of the furrow (nine inches) to find the depth,

DESCRIBE Fig. 10. a semicircle on AB the breadth, make the angle DAB equal the angle of position (30°), and from C , where it cuts the semicircle, draw CB for the depth, which, measured on the same scale, is $4\frac{1}{2}$ inches.

By calculation, as $\text{Rad.} : AB :: \text{sine of the angle } CAB (30^\circ) : CB (4\frac{1}{2}).$

III.

SUPPOSE the depth to be plowed is six inches, and that the angle of position the sods are wished to be laid in be 40 degrees, required the breadth of the furrow necessary to place them in this position.

DRAW, Fig. 11. an indefinite line DB, and at B make the angle DBC equal to the complement (50°) of the angle of position, set the depth from B to C, and at C erect a perpendicular to BC, where it cuts DB at A, will give AB, the breadth required 9,3 inches.

By calculation, as sine CAB (40°) : CB :: Rad. : AB (9,3).

FROM what is stated, we hope that artisans in every part of the country may be enabled to make ploughs that shall perform their operations with the least loss of power, especially if they attend to the height of the horses shoulder, and the depth intended to be ploughed.

A PARING plough of a new construction was invented by the late Mr. Cotesworth of Wynyard, in the county of Durham, which performs its work very well: See Fig. 12.

THE beam AB, 78 inches long, is fixed to a frame CDEF, 63 inches long by 37 broad, in this frame, a little before the point of the share, are fixed two wheels GG of 18 inches diameter.

HH are the stilts, I the mould-board of wood, K the share, a flat triangular piece of iron, 20 inches by 14 (with a steel edge), fixed to the bottom of the blough by two screws, one in the sole, and one in the mould-board; on the land-side of this share a small piece, L, is turned up perpendicular to the share, to cut the sod instead of a coulter.

THE wheels GG are raised or lowered, and fixed by wedges to regulate the depth to be paired; that on the right hand runs upon the pared surface, and that on the left, upon the grass or unpared surface.

WITH this plough an acre a day can be pared, from one to one inch and an half thick.

As many of our readers may be unacquainted with the old Scots plough, the following description of that ancient and unwieldy implement may not be unacceptable. Its several parts consisted of a head, a beam, a sheath, a wrest, a mould-board, two handles or stilts, which were connected by two sticks or pieces of wood, called *rungs*; all these were of wood, but the sock and coulter,

with two shoes on the sole and side of the wrest, were of iron. The purposes of these different parts were as follows. The head and sock opened the land below, the coulter cut the surface, the wrest and mould-board raised the earth, and turned it over, the beam fixed the draught, and kept the several parts together, and by the handles the plough was managed and directed. The sock, or share, was of a spiked form, and acted as a miner, not cutting the furrows square in the bottom, as must be the case with the ploughs now in use, when properly constructed.

FROM this description, the defects of the old Scots plough may be easily ascertained. Owing to the way in which the sock or share operated, a great deal of the ground was left to be turned over by the wrest; and this part acted as a forcer, without having influence to accomplish the operation unless when impelled by considerable strength. The necessity of having a strong impelling power to execute the work sufficiently, influenced the ploughman, in most cases, to keep the wrest upwards, by which means he lessened the quantity of power that was required to carry forward the draught, though, by acting in this

way, he rendered the work executed proportionably defective; as in such instances it was baulked below, and imperfectly shouldered upon the surface. These defects were sufficiently ascertained, when attempts were made to lessen the size of the old Scotch plough, and to work the implement with two horses instead of three or four, the number usually employed in former times. Even the improved Rotherham plough was in some respects similarly deficient, till the mould-board received a greater curve, and was placed lower down, and more upon a level with the heel, than was usually the case at its first introduction. Bad and lazy ploughmen are at all times disposed to keep the furrow side up, thereby baulking the ground less or more, merely that the draught may sit easier upon the horses, without reflecting upon the serious injury occasioned to the soil, and consequently to the crops.

THE old Scots plough was, however, favourable for working strong land, and for all lands recently brought under cultivation. At the time it was used, therefore, no other could be worked perhaps with equal advantage. From this consideration, it may be retained with propriety in

certain parts of the country, where improvements are only in their infancy; though in every other, where any thing like perfect cultivation has been introduced, the improved Rotherham plough may be used with infinitely greater advantage. It will be attended with a saving to the farmer, and to the country of no small importance. Two horses in the latter will nearly plough as much ground as four in the former, and in our opinion to much better purpose when the implement is properly constructed. Now, the expence of keeping two horses is not less than sixty pounds *per annum*, besides the wages and board of a driver, which at least will amount to twenty pounds more. It is more owing to causes of this nature, than to any increase in the price of produce, that the rent of land has increased so prodigiously. The plough and thrashing machine are the two capital implements of husbandry; and to the improvement upon the one, and the introduction of the other, the proprietors of land are in a great measure indebted for the increased value of their property. How much is it to be lamented, that the merits of the two men who improved and introduced these implements have not been duly considered and rewarded! Had this been done,

a debt, not recoverable in a law court, would have been discharged, and encouragement held out to other ingenious mechanics or artizans to exert their endeavours in making improvements upon every implement already in use, and in devising new ones of greater powers and capacities for executing the different branches of rural labour.

WHEEL ploughs are much in vogue in several English counties, though not used in Scotland, except in some parts of Kincardine and Aberdeenshires, where they were introduced by the late Mr Barclay of Urie. That ploughs of this description may do very well upon flat sandy soils, we entertain no doubt; nay, that they may be guided by ploughmen less skilful than those intrusted with the management of swing or sledge ploughs, we mean not to question. Still it has always appeared to us, that so much additional resistance must be created by the action of the wheels; especially when the surface is soft, as is sufficient to counteract, and even to exceed any benefit gained from the steadiness of draught, or the equality of breadth and depth of the furrow taken. With respect to wheel ploughs, our

opinion is not very different from the one given by Lord Kames. That respectable agriculturist viewed them as trifles, describing the pivots of the wheels as constantly going wrong, and, on account of their being frequently chocked with earth, as increasing the friction instead of diminishing it.

BESIDES the improved Rotherham plough, now in general use, and worked by two horses, another implement, constructed upon the same principles, but of smaller dimensions, and considerably lighter, is used for cleaning beans, potatoes, and turnips. This plough is wrought by one horse, and does the business completely. It is of advantage to put a piece of plate iron betwixt the coulter and sheath or head, that the loose earth may not fall through upon the young plants. A horse hoe, called a scraper, is also used to clean drilled crops on light soils, and is very efficacious; when annual weeds are to be destroyed, but when quicken or other root weeds are in the ground, a deeper furrow is required, and in that case the light Rotherham plough becomes necessary.

To any one who has been in the habit of seeing every kind of soil ploughed, in the completest manner, by an improved swing plough, drawn by two horses, it must appear highly absurd, that the lightest soils of Middlesex, Surry, and many other English counties, should be worked by five or six strong horses, yoked to a ponderous unwieldy implement ; yet with an impelling power of such magnitude, the furrow is generally of less depth than the one taken by the improved plough drawn only by two horses. The difference of expence in these two cases, must at least amount to thirty shillings per acre in favour of farmers who use the improved swing plough ; and this may be given as one of many reasons why the rent of arable land is so much lower in England than in Scotland. There are some obstacles to the improvement of agriculture which farmers cannot remove ; but to purchase proper implements, and to work them in a suitable manner, is certainly within the power of every one of them. It must, therefore, appear surprising, that a great proportion of English farmers are so obstinately wedded to ancient customs and prejudices, as to persist in using implements highly pernicious to the interests of agriculture and the

prosperity of the state, without being of the slightest benefit to themselves. A spirit of inquiry, however, has now gone abroad ; and it is to be hoped, that the consequences thereof will serve to correct the above and other errors. So many English farmers have of late visited Scotland, and made sedulous inquiries respecting the husbandry of that country, as inclines us to believe that improvements in one part of the island will soon be diffused over the whole. But a stronger reason for inducing us to think that the number of horses used in a plough will shortly be lessened, may be gathered from the desire manifested by many English proprietors to obtain rents of a similar extent to those received by their Scottish brethren. It is obvious that this cannot happen, so long as the produce of land is wasted and consumed by a parcel of idle or superfluous horses ; therefore, we would not feel surprise, were long teams interdicted by English proprietors, or that they refused to accept of a tenant, who did not previously bind and oblige himself to use the improved swing plough drawn by two horses ; which implement, with the exception of the thrashing machine, may justly be reckoned the

greatest boon hitherto bestowed on British agriculture.

MR JEFFERSON, late President of the United States of America, who has cultivated the study of agriculture with considerable success, has given the following description of a plough-ear or mould-board, which shall be given in his own words.

THE body of a plough ought not only to be the continuation of the wing of the sock, beginning at its posterior edge, but it must also be in the same plane. Its first function is to receive horizontally the earth from the sock, to raise it to the height proper for being turned over; to present in its passage the *least possible resistance*, and consequently to require only the *minimum* of moving power. Were its functions confined to this, the wedge would present, no doubt, the properest form for practice *; but the object is

* If the object were merely to raise the sod of earth to a given height by a determinate length of ear, without turning it over, the form which would give the least resistance would not be exactly that of a wedge.

also to turn over the sod of earth. One of the edges of the ear ought then to have no elevation, to avoid an useless wasting of force; the other edge ought, on the contrary, to go on ascending until it has passed the perpendicular, in order that the sod may be inverted by its own weight; and to obtain this effect with the least possible resistance, the inclination of the ear must increase gradually from the moment that it has received the sod.

IN this second function the ear acts then like a wedge situated in an oblique direction or ascending, the point of which rests horizontally on the earth, while the other end continues to rise till it passes the perpendicular. Or, to con-

with two plane faces; but the upper face ought to be curvilinear, according to the laws of the solid of least resistance described by mathematicians. But in this case the difference between the effect of the wedge with a curved face, and that of a wedge with a plane face, is so small, and it would be so difficult for workmen to construct the former, that the wedge with a plane face ought to be preferred in practice, as the first element of our method of construction.

sider it under another point of view, let us place on the ground a wedge, the breadth of which is equal to that of the sock of the plough, and which in length is equal to the sock from the wing to the posterior extremity, and the height of the heel is equal to the thickness of the sock : draw a diagonal on the upper surface from the left angle of the point to the angle on the right of the upper part of the heel ; slope the face by making it bevel from the diagonal to the right edge, which touches the earth : this half will evidently be the properest form for discharging the required functions, namely, to remove and turn over gradually the sod, and with the least force possible. If the left of the diagonal be sloped in the same manner, that is to say, if we suppose a straight line, the length of which is equal at least to that of the wedge, applied on the face already sloped, and moving backwards on that face, parallel to itself, and to the two ends of the wedge, at the same time that its lower ends keeps itself always along the lower end of the right face, the result will be a curved surface, the essential character of which is, that it will be a combination of the principle of the wedge, considered according to two directions,

which cross each other, and will give what we require, a plough-ear presenting the least possible resistance.

THIS ear, besides, is attended with this valuable advantage, that it can be made by any common workman by a process so exact, that its form will not vary the thickness of a hair. One of the great faults of this essential part of the plough is the want of precision, because workmen, having no other guide than the eye, scarcely two of them are similar.

IT is easier, indeed, to construct with precision the plough-ear in question, when one has seen the method which furnishes the means once put in practice, than to describe the method by the aid of language, or to represent it by figures. I shall, however, try to give a description of it.

LET the proposed breadth and depth of the furrow, as well as the length of the head of the plough, from its junction with the wing to its posterior end, be given, for these data will determine the dimensions of the block from which the ear of the plough must be cut. Let us sup-

pose the breadth of the furrow to be nine inches, the depth six, and the length of the head two feet; the block then (Fig. 22.) must be nine inches in breadth at its base bc , and $13\frac{1}{2}$ inches at its summit ad ; for, if it had the top only the breadth ae equal to that of the base, the sod, raised in a perpendicular direction, would, by its own elasticity, fall back into the furrow. The experience which I have acquired in my own land has proved to me, that in a height of 12 inches the elevation of the ear ought to go beyond the perpendicular four inches and an half, which gives an angle of about $20\frac{1}{2}^\circ$, in order that the weight of the sod may in all cases overcome its elasticity. The block must be 12 inches in height; because if the height of the ear were not equal to twice the depth of the furrow, when friable and sandy earth is tilled, it would pass the ear, rising up like waves. It must be in length three feet, one of which will serve to form the tail that fixes the ear to the stilt of the plough.

THE first operation consists in forming this tail by sawing the block (Fig. 23.) across from a to b on its left side, and at the distance of 12

inches from the end $f g$; then continue the notch perpendicularly along $b c$ till within an inch and a half of its right side; then taking $d i$ and $e h$, each equal an inch and a half, make a mark with the saw along the line $d e$, parallel to the right side. The piece $a b c d e f g$ will fall off itself, and leave the tail $c d e h i k$, an inch and a half in thickness. It is of the interior part $a b c k l m n$ of the block that the ear must be formed.

By means of a square, trace out on all the faces of the block lines at an inch distance from each other, of which there will necessarily be 23: then draw the diagonals $k m$ (Fig. 24.) on the upper face, and $k o$ on that which is situated on the right; make the saw enter at the point m , directing it towards k , and making it descend along the line $m l$ until it mark out a straight line between k and l (Fig. 25.); then make the saw enter at the point o , and, preserving the direction $o k$, make it descend along the line $o l$ until it meet with the central diagonal $k l$, which had been formed by the first cut: the pyramid $k m n o l$ (Fig. 26.) will fall of itself, and leave the block in the form represented by Fig. 25.

IT is here to be observed, that in the last operation, instead of stopping the saw at the central diagonal kl , if we had continued to notch the block, keeping on the same plane, the wedge $lmno$ $k b$ (Fig. 24.) would have been taken away, and there would have remained another wedge, $lokb ar$, which, as I observed before, in speaking of the principle in regard to the construction of the ear, would exhibit the most perfect form, were the only object to raise the sod; but as it must also be turned over, the left half of the upper wedge has been preserved, in order to continue, on the same side, the bevel to be formed on the right half of the lower wedge.

LET us now proceed to the means of producing this bevel; in order to obtain which, we had the precaution to trace out lines around the block before we removed the pyramid (Fig. 26.). Care must be taken not to confound these lines, now that they are separated by the vacuity left by the suppression of that pyramid (Fig. 25.). Make the saw enter in the two points of the first line, situated at the places where the latter is interrupted, and which are the two points where it is intersected by the external diagonals ok and mk ,

continuing the stroke on that first line till it reach on the one hand the central diagonal $k l$, and on the other the lower right edge $o h$ of the block (Fig. 25.) the posterior end of the saw will come out at some point situated on the upper trace in a straight line with the corresponding points of the edge and the central diagonal. Continue to do the same thing on all the points formed by the intersection of the exterior diagonals and lines traced out around the block, taking always the central diagonal, and the edge $o h$ as the term, and the traces as directors: the result will be, that when you have formed several cuts with the saw, the end of that instrument, which come out before at the upper face of the block, will come out at the face situated on the left of the latter; and all these different cuts of the saw will have marked out as many straight lines, which, extending from the lower edge $o h$ of the block, will proceed to cut the central diagonal. Now, by the help of any proper tool, remove the sawn parts, taking care to leave visible the traces of the saw, and this face of the ear will be finished*. The traces will serve to show how the

* A better idea of the result of the operation here described, may be conceived from the two figures 30

wedge which is at the right angle rises gradually on the direct or lower face of the wedge, the inclination of which is preserved in the central diagonal. One may easily conceive and render

and 31, which were originally drawn in perspective by M. Valencienne, assistant naturalist to the *Museum National d'Histoire Naturelle*. Suppose the saw cuts the lines $m k$, $o k$, (Fig. 30.) in the points x and t , taken in the traces $x \zeta$ and $t s$, situated in the same plane, parallel to $b a a r$, and the prolongations of which, on the triangles $m k l$ and $o k l$, are the lines $a z$ and $t z$; the saw must then penetrate the block remaining in the plane in question until its edge has arrived at the point s , and at the same time touch the point z of the central diagonal $k l$. The same edge of the saw will come out at some point y of the face $m k l$, so that the three points s , z , y , will be in the same straight line. But if this operation be repeated in different places of the lines $m k$, $o b k$ from k to a certain height, the points of the face $m k b$, at which the saw comes out, will form a curve $k y n$. Beyond this height the saw, always directed in such a manner that at the end of its motion it shall touch at the same time the edge $o h$, and the central diagonal $k l$ will come out at other points situated on the posterior face $a b m l$, and the series of these points will form a second curve $n l$, which will meet

sensible the manner in which the sod is raised on the ear, which we have described, by tracing out on the ground a parallelogram two feet long and nine inches broad, as $abcd$ (Fig. 27.): then placing in the point b the end of a stick $27\frac{1}{2}$ inches in length, and raising the other end 12 inches above the point e ; (the line de , equal to four inches and a half, represents the quantity which the height of the ear exceeds the perpendicular.) When this is done, take another stick 12 inches

the first in the point n . These two curves being traced out, let us suppose straight lines drawn to the places where the saw stopped each time that it touched the diagonal kl , and of which one, as already said, passes through the points s, z, y ; and let us conceive a surface touching all these straight lines, and whose limits, on the one hand, shall be the curves $ky n, n l$, and on the other the edge oh , this surface, which must be uncovered by sections made with a proper instrument, will form one of the faces of the ear. The latter is represented Fig. 31. and the face in question is that which appears before, and which is indicated by $inlor$. It will be remarked, that the angle situated towards h (Fig. 30.) on the part $kcdieh$ of the block has also been cut off by a section made from d to r , agreeably to what will be said hereafter.

in length, and, placing it on $a b$, make it move backwards, and parallel to itself from $a b$ to $c d$, taking care to keep one of its ends always on the line $a d$; while the other end moves along the stick $b e$, which here represents the central diagonal. The motion of this stick of 12 inches in length will be that of our ascending wedge, and will show how each transverse line of the sod is carried from its first horizontal position until it be raised to a height which exceeds the perpendicular so much as to make it fall inverted by its own weight.

BUT to return to our operation:—it remains to construct the lower part of the ear. Invert the block, and make the saw enter at the points where line $a l$ (Fig. 30.) meets with the traces, and continue your stroke along these traces until both ends of the saw approach within an inch, or any other convenient thickness, of the opposite face of the ear. When the cuts are finished, remove, as before, the sawn pieces, and the ear will be finished*.

* We shall here add to this description an illustration similar to that given in regard to the anterior face of the ear. The thickness of the latter being deter-

It is fixed to the plough by mortising the fore part ob (Fig. 25. and 31.) into the posterior edge of the sock, which must be made double, like the case of a comb, that it may receive and secure

mined by that of the part $kcdieh$ (Fig. 30.), or, what amounts to the same thing, by the length of the lines ck, di, eh , let us first conceive that there has been traced out, proceeding from the point c , the curve cup parallel to kyn , and then proceeding from the point p , the curve $p\delta$ parallel to ln . Let us next suppose that the saw cuts the edge al of the face $abml$ in the point δ , situated in the same plane as $x\zeta$ and ts , which plane has been taken for example in regard to the anterior face of the ear. The saw must be directed along the traces $\delta\zeta$ and δs in such a manner, that its motion shall stop at the term where its edge on the one hand shall touch the curve cp in the point u situated on the trace xz , and on the other shall be situated parallel to the line $sz y$ at which the saw stopped on the other side of the ear. The edge of the saw will then cut the face $alor$ in some point ε , so situated that the straight line drawn through that point and the point u shall be parallel to the straight line which passes through the point $sz y$.—If you continue in the same manner cutting with the saw different points of the edge al , those by which it comes out will form on the face $alor$ a curve $\varepsilon\mu\delta$; and if through these points, and those corresponding to them

this fore part of the ear. A screw nail is then made to pass through the ear and the handle of the sock at the place of their contact, and two other screw-nails pass through the tail of the ear and the right handle of the plough. The part of the tail which passes beyond the handle must be cut diagonally, and the work will be finished.

IN describing this operation I have followed the simplest course, that it may be more easily conceived; but I have been taught, by practice, that it requires some useful modifications. Thus, instead of beginning to form the block as represented *a b c d* (Fig. 28.), where *a b* is 12 inches in length, and the angle at *b* is a right one, I cut off towards the bottom, and along the whole length *b c* of the block, a wedge *b c e*, the line *l* being equal to the thickness of the bar of the sock (which I suppose to be $1\frac{1}{2}$ inch); for, as the face of the wing inclines from the bar to the

in the lines *c p*, *p s*, there be drawn straight lines, such as that which passes through the points *e*, *u*, and which we have taken as an example, the surface touching these straight lines, and uncovered by means of any sharp instrument, will form with the remainder *e h o l s μ ε* of the plane *a l o r*, the posterior face of the ear, such as is represented Fig. 31.

ground, if the block were placed on the sock, without taking into the account this inclination, the side ab would lose its perpendicular direction, and the side ad would cease to be horizontal. Besides, instead of leaving at the top of the block a breadth of $13\frac{1}{2}$ inches from m to n (Fig. 29). I remove from the right side a kind of wedge nki of $1\frac{1}{2}$ inch in thickness; because experience has shown me, that the tail, which by these means has become more oblique, as ci instead of ki , fits more conveniently to the side of the handle. The diagonal of the upper face is consequently removed back from k to c ; and we have mc instead of mk , as above. These modifications may be easily comprehended by those acquainted with the general principle.

IN the different experiments to which ears have been subjected, to determine the quantity by which the right upper side of the block passes beyond the perpendicular, and to fix the relation between the height and the depth of the furrow, they were made only of wood; but since my experiments have convinced me, that for a furrow nine inches broad and six in depth, the dimensions I

have given are the best, I propose in future to have the ears made of cast iron.



SECT. II.

Harrows.

THESE beneficial implements are of various sizes and dimensions ; but the harrow most commonly used consists of four wooden bulls, with cross mortised sheaths, each bull containing five teeth, of from five to seven inches in length below the bulls, the longest being placed forwards. Harrows of this kind, drawn by one horse, are generally used on most farms for all purposes, though on others large brake harrows, consisting of five bulls, each containing six teeth, and worked by two horses, are employed during the fallow process, and for reducing rough land. Some of these brake harrows are constructed with joints, so as to bend, and accommodate their

shape to the curvature of ridges. A small harrow with short teeth is also used for covering grass seeds, though we have rarely seen any detriment from putting grass seeds as deep into the ground as the teeth of ordinary sized harrows are capable of going.

THE object of harrowing being both to drag out quicken weeds, and to cover the seed when sown, it is obvious that implements of different sizes are not only necessary, but even that these implements should be worked in different ways, according to the strength and condition of the soil on which they are employed, and the nature of the work to be executed. When employed to reduce a strong obdurate soil, not more than two should be yoked together, because they are apt to ride and tumble upon each other, and thus impede the work, and execute it imperfectly. It may also be remarked, that on rough soils harrows ought to be driven as fast as the horses can walk; because their effect is in direct proportion to the degree of velocity with which they are driven. In ordinary cases, and in every case where harrowing is meant for covering the seed, three harrows are the best yoke, because they fill

up the ground more effectually, and leave fewer vacancies, than when a smaller number is employed. The harrow-man's attention, at the seed-process, should be constantly directed to prevent these implements from riding upon each other, and to keep them clear of every impediment, from stones, lumps of earth, or clods, and quickens or grass roots; for any of these prevents the implements from working with perfection, and causes a mark or trail upon the surface, always displeasing to the eye, and generally detrimental to the braird or vegetation of the seed. Harrowing is usually given in different directions, first in length, then across, and finally in length, as at first. Careful husbandmen study, in the finishing part of the process, to have the harrows drawn in a straight line, without suffering the horses to go in a zigzag manner, and are also attentive that the horses either fairly upon the ridge, without making a curve at the outset. In some instances, an excess of harrowing has been found very prejudicial to the succeeding crop; but it is always necessary to give so much as to break the furrow, and level the surface, otherwise the operation is imperfectly performed.

HARROWS wholly composed of iron have lately been tried by some respectable agriculturists; but, in our humble opinion, not with much advantage. On soft loams and sands, and even on clay soils, free of stones, iron harrows may be used, though they are by no means calculated for rocky lands. Besides, the expence of such harrows is considerable.

SECT. II.

On Rollers.

THE roller is an implement frequently used for smoothing the surface of land when in tillage, especially when the processes of summer fallow are going forward. Several kinds of rollers are used in Britain. Some are made of stone, others of wood; and, of late, rollers made of yetlin or cast metal are coming into use, according to the nature of the operation intended to be performed. The only material difference in roll-

ers is their weight ; but it should be attended to, when a roller is made of large diameter, that its weight ought to be the greater ; for, in proportion to the largeness of its diameter, will be the extent of surface upon which the roller rests. The weight of a roller ought therefore to be in proportion to its diameter, otherwise its effect will be proportionably diminished.

ROLLING, however, is a modern improvement, and used for different purposes. In the first place, it is of great advantage to roll young grasses after the ground is stoned, because the scythe can then be placed nearer the surface, and the crop cut more equally than when the operation is neglected. 2dly, Land on which turnips are to be cultivated can rarely be made fine enough, without the repeated use of this implement. And, 3dly, The process of summer fallow, upon strong soils, is much advanced by rolling, because, without its aid, the large and obdurate clods cannot be reduced, or couch-grass eradicated. From these circumstances it will readily appear, that rollers of various sizes and dimensions are required on every farm. Wooden rollers, drawn by one horse, answer very well for

grass and turnip land ; but massy stone rollers, drawn either by two or three horses, are absolutely necessary on clay soils when under the fallow process. Most farms are imperfectly provided with these implements. Every one may have them smaller or larger, but few are provided with a sufficient number. It is obvious that when a large field is to be rolled, a number of rollers ought at once to be set at work, otherwise an opportunity may be lost, never to be regained. The deficiency is most conspicuous when barley is taken after turnips in a dry season. From poaching the ground with carts, in order to carry off the crop, and even by the treading of sheep, a degree of stiffness is contracted, which requires the use of the roller before grass seeds can be sown. Suppose that a field so circumstanced should have got two-thirds of the intended harrowing, and that the remainder is reserved till rolling is given, a delay takes place, at all events, before grass seeds can be sown ; and, where only one roller is employed, that delay may be increased to such a length as to endanger both barley and seeds, should wetness intervene before the whole operations are completed.

ON all occasions it is most beneficial to roll across, because, when going in length, the implement is of small benefit to the furrows, the slightest acclivation of the ridges preventing the work from being equally performed. The expedition which takes place when rollers are used, compared with the tedious and expensive process of breaking clods with malls, formerly the general custom, sufficiently proves the importance of these implements, though it deserves to be remarked that, when rolling is bestowed upon a spring-sown field, harrowing it afterwards is of great advantage. By harrowing when the clods are reduced, the earth stands the effects of rain better afterwards, and does not consolidate so firmly as when that process is neglected.

SECT. IV.

On Wheel Carriages used in Husbandry.

To drive out manure, bring home corn from the field, and carry it to market, after being separated from the straw, are operations which, on arable farms, occupy one-fourth of the labour at least. To employ carriages, therefore, that are calculated to execute these operations with the greatest facility, and at the least possible expence, would seem to be a matter of rural economy highly deserving of serious consideration. This circumstance, however, does not weigh so much with the farmer as it ought to do ; hence we notice, in many districts, that wheel carriages are clumsily constructed, often of inconvenient dimensions, and rarely adapted to the nature of the work to be executed, or the condition of the roads over which they are to pass. In England this is particularly the case ; heavy waggons being, in numerous instances, employed to per-

form branches of rural labour, which would be much more easily and cheaply executed by small carts. In fact, waggons are of no benefit in agriculture, unless a long *drive* is to be taken. To load and unload them is difficult. Much time is unnecessarily consumed, especially when the taking out of manure is the work to be performed; while, in every case, these heavy carriages prove destructive to the roads, and entail an expence on the public, chiefly on agriculturalists, of incalculable magnitude.

EVEN the long carts, mounted on narrow wheels, and seven feet long, often used in England, are inconvenient for husbandry purposes, and detrimental to the roads. These carts, which are drawn by three horses, generally yoked in a line, cannot be set up, when loaded with manure, half so easily as the *coup* carts of Scotland; indeed, in many cases, it is never attempted to draw the manure out of them; the driver, mounted on the top, disloading the carriage with a grape or shovel, according to circumstances. It is not necessary to enlarge on these inconveniences, because every agriculturalist, not obstinately bigotted to ancient usages, will at once discern their

extent, and acknowledge that a remedy would be highly desirable.

THE most useful kind of carts, for the general purposes of farming, are those used in the low country districts of Scotland. These carts contain, within the boards, somewhat more than a cubic yard ; but, when heaped with dung, will carry $1\frac{3}{4}$ yards with ease. The wheels, generally 54 inches in height, are mounted upon iron axletrees, which, by diminishing the friction, and lessening the resistance, renders them more easily drawn. Formerly, the wheel, from a mistaken principle, was much dished ; but a better knowledge of mechanics has occasioned that error to be rectified ; the spokes of the wheel being perpendicular to the axis, and the circumference pressing in that direction from all sides towards the center, the wheels move equally and smoothly round ; whereas formerly, when the circumference was so much without the center, the wheels, in place of touching the axletree equally, and moving round smoothly, formed a kind of angle with it, which considerably increased the resistance, and destroyed the axle and bushes.

WHEN corn or hay is to be brought home from the field, a long cart, open spoked, and lightly constructed, is placed upon the wheels of the cart already mentioned; and none seems better adapted for such purposes, because none are better calculated to admit of a large load with the least possible trouble to the driver, and to the horses. The only improvement called for on these carts, is lining them close on the bottom, and partially on the sides, with thin boards, whereby much grain would be saved that is now dropped on the road, or wasted in the stack-yard. The expence of lining them in this way would be trifling, and the additional weight thereby given to the horses inconsiderable.

THE carts which we have described as used for farm purposes in Scotland are almost in every case wrought by two horses, though several farmers employ smaller ones, drawn by one horse, for driving corn to market, which is considered as being the most profitable method. Though little doubt can be entertained on this point, when the cart is to travel on a regular main road, yet it may safely be questioned, whether one-horse carts can with propriety be recommended for the

general home-work of a farm, where roads are generally bad, where often none are made, and where the cart has to travel over a ploughed field, sinking four or five inches at one place, and impeded by large clods at another. Under such circumstances, an additional horse seems to be requisite, especially when the weight of the draught sinks the carriage down, and thus lessens the powers of the shaft horse, and renders him unable to get forward. The second horse, if yoked in a line, is able to do more than the one in the shafts, because, when the carriage sinks into the soil, the line of direction of the draught is materially altered. In every other case, we are quite satisfied that one-horse carts deserve to be preferred; not only because a proportionally greater loading will be carried by them, over a road decently repaired, but also, because less damage is done to the roads than when heavier draughts are taken, and more horses employed.

BROAD wheels are pretty common in England, but not much used in Scotland, though it is evident that their general introduction would be attended with many advantages. It is easy, however, to account for their being hitherto neglect-

ed, though, perhaps, the very circumstances which produced that neglect will, in some measure, occasion its continuance. Roads in England were repaired at an earlier period than in Scotland ; and unless a public road is previously put in good order, it is impracticable, or at least attended with much inconvenience, to pass over it with broad wheels, so long as the majority of carriages which travel that way are mounted upon narrow wheels. The latter make a rut or track into which the former cannot go, and hence they are impeded at every step, and made to go unsteady. Were all wheels of the broad kind, and all shod in a suitable manner (for in some cases we have seen wheels apparently with broad feloes, shod in such a way as to do equal injury to the road, as those which in reality were constructed with narrow ones), the public would be eminently benefited. The expence of supporting the roads of the kingdom, from an increase of trade, and an increase of improvement, has of late been augmented prodigiously. Perhaps it is not short of three millions *per annum* ; and there seems to be no method of lessening it, but by resorting to a general use either of broad wheels or one-horse carts, which undoubtedly would

cause a considerable reduction in the expence. The legislature, sensible of the benefit derived from broad wheels, has given a premium upon their use, by lessening the rate of tolls 50 *per cent.* in their favour. This is an apparent advantage to be sure, though in reality no important benefit can be gained, either by the public or individuals, so long as narrow wheels are generally used. It would seem that nothing short of a compulsory act can bring broad wheels into universal practice, because the individual who wishes to use them is deterred by the unavoidable loss which he must sustain, so long as the great majority of wheels are of a different construction. It is impracticable to make good work in one ridge with two ploughs, one of which is narrow set and the other wide set in the mould-board; and it is equally impracticable to travel a public road with broad wheels, if narrow wheels are permitted, especially if the majority of wheels are of that description. The introduction of broad wheels can therefore only be accomplished by taking it up as a general measure. Were caprice, or obstinacy, suffered to act, individuals would be found influenced by these principles, and of sufficient number to pre-

vent the improvement from being accomplished. We therefore repeat, that a compulsory measure seems to be the only effectual way of introducing this manifest improvement ; and were an exception made in favour of one-horse carts, the improvement would not be much abated.

BEFORE concluding this Section, we may state that, if a fair comparison is made betwixt the waggon loads of England and the cart loads of Scotland, it will be found, that the cart, in point of economy, is the preferable carriage. It is well known, that the main objection to two-horse ploughs in England is the dislike shewn by the waggoners to have their teams broken or separated. We remember well of a gentleman in Hertfordshire informing us, that his carter would not take more hay to the London market with five horses than a load (90 stone Scottish weight), and cannot forget the surprise he expressed when he learned that the author of this work had actually driven one-fourth more to market *with a single horse*. The foregoing objection would certainly be instantly removed, were two-horse ploughs and double carts commonly used, and every ploughman employed to

keep and work his own pair of horses. Under a system of this kind, a saving to the public would be gained, the extent of which cannot be calculated, but must be immense.

SECT. V.

On Drilling Machines.

THE most perfect husbandry is practised when garden culture can be imitated ; and the greatest attention is paid to the management of the field when the seed process is regularly executed. These principles, abstractly considered, may be regarded as intimately connected with the practice of rural economy, though they are not to be received as applicable in every case respecting the seed of plants, or the mode in which it is to be deposited in the field. Regularity ought to be studied at all times ; but regularity may be sufficiently followed, without imitating, at all times,

the husbandry of a garden, or acting according to the rules which influence cultivators in that department. The superiority of garden soil, the attention paid in cultivating it, and the value of the crops raised, afford every encouragement to a refinement of management, greatly exceeding what can be executed in the field, where a deficiency prevails in each of these particulars ; but, even were the garden and the field of similar richness, and were the crops that are cultivated in each of equal value, still we apprehend that the proper culture is dissimilar, and that practices good in a garden, where small seeds and leguminous crops only are cultivated, may be improper and unprofitable, when the cultivation of corn is to be attempted.

THE Row Husbandry, or the method of cultivating crops of wheat, barley, and oats, according to the drill system, has many votaries, and is less or more followed in many arable districts of Great Britain. We apprehend that in this way the greatest number of British soils cannot be successfully cultivated, and shall briefly state our reasons for entertaining this opinion. 1. The climate of Britain being very variable, sufficient

time is seldom to be got for accomplishing the previous operations of the row husbandry ; therefore, when the seed season arrives, drilling is either imperfectly executed, or delayed so long as to render the after crop precarious and uncertain. 2. The soil of Britain, in nine cases out of ten, is unfit for the row husbandry, being too wet, too poor, too stiff, and therefore not to be cultivated or sown with the implements used in the row husbandry. 3. The culmiferous grains of wheat, barley, oats, and rye, may be raised more abundantly, and at less expense, according to the old-fashioned or broad-cast system, than by what is called the row husbandry. When these grains are drilled, they are greatly exposed to the weather, and liable to be broken down by every gale of wind. They also tiller or stool, so long as any interval remains for the spreading of their roots, which occasions an inequality in the ripening of the grain, of considerable importance to the manufacturer. From these circumstances, we are led to believe, that the row husbandry cannot be profitably exercised with any of the culmiferous varieties, though with the leguminous ones of beans, turnips, potatoes, &c. (plants which probably derive a large portion of nourish-

ment from the air, or at least cannot be cultivated with advantage where the free circulation of air is wanting,) the row husbandry is not only beneficial in the first instance, but of important use towards cleaning the ground; and preserving it in good condition afterwards.

THOUGH eagerly disposed to promote the drilling of turnips, potatoes, beans, and all the varieties of the leguminous tribe, we cannot go one step farther in recommending the drill husbandry upon general principles. We acknowledge that, upon certain soils, wheat, barley, and oats, may be successfully cultivated, according to the row husbandry; and we have seen that system exercised to the manifest benefit of the persons by whom it was executed. Still as applying to the great majority of British soils, the row husbandry is inexpedient and unprofitable, and with them the culture of culmiferous crops, according to the broad cast system, must, by every practical agriculturist, be received as most beneficial and advantageous.

HAVING said so much concerning the inexpediency of drilling all crops, we shall now say a

few words concerning the drills that are used, and the advantages which may be derived from these implements.

THE drills first used were constructed upon simple principles, and wrought in the wheel-barrow way, by a person who pushed them along in the furrow, when beans were to be sown, and on the top of a small narrow ridge of ground, when turnips were cultivated. A drill of this kind is generally used for beans at this day, though larger ones, sowing two or three drills at a time, and drawn by a horse, have lately been brought into practice. The hand turnip-drill, however, is almost laid aside, it having been found that the seed sown in that way did not vegetate, from not being put deep enough into the earth. Horse-drills were then resorted to; and these are constructed with such precision, as not only to distribute the seed with mathematical exactness, but also to ensure vegetation in the driest seasons, unless the moisture, from negligence, has been suffered to evaporate. We are convinced that these large drills are infinitely better calculated for the turnip husbandry than small ones; but the same superiority is not discernible in the hus-

bandry of beans, because in many soils and situations it is impracticable to form a drill at seed-time; therefore the single row barrow is run in the furrow after the third plough, circumstances not permitting the seed process to be more accurately executed. Where drills can be made up, that method ought undoubtedly to be followed; but the real bean soils being generally of a wet and tenacious nature, it rarely happens, unless in favourable seasons, that it is practicable.

MR BAILEY of Chillingham has done much to render drills more perfect than formerly; and being intimately acquainted with mechanics, as well as good husbandry, he has, in the instances alluded to, availed himself of his extensive information, and brought these implements to a degree of perfection not to be expected from the labours of the mere mechanic.

WHEN the mode of cultivating turnips on one bout ridges was introduced, the only drill used was a hollow cylinder of tin, with a small hole in the bottom, through which the seed was shook: If this orifice be made of such size as to deposit a proper quantity of seed, it is very liable to stop,

and of course large spaces are totally missed ; if made so wide as to prevent this inconvenience, it then sows far too much : This defect induced Mr Bailey, some years since, to construct one upon different principles, which is now coming into general use.

THE most essential parts of this drill consist of a solid cylinder C (Fig. 32.), of iron or brass, two inches diameter, and one inch broad ; on the surface are made or punched 12 cavities, of the form of a semi-egg, cut lengthways, and so deep as to hold four or five seeds each. On the back part of this cylinder (a little below the top) is placed the hind part of the hopper, to which is fixed a piece of iron or brass (GA) one inch long, and three quarters broad, hollowed on the inside into the form of a Gothic arch (as in Fig. 33.) the sides of which meeting the sides of the cavities in an *oblique angle*, prevent the seeds from bruising ; at the lower end of this piece of iron (which may be called a gatherer) is made a slit, three tenths of an inch long, and one-tenth wide ; and at the back of it a thin flat piece of iron (TE) moves up and down, by means of a screw S, at the top of the hopper,

which enlarges or lessens the orifice O, directly above the cavities, and increases or diminishes the quantity of seed delivered, as the operator thinks necessary. This slip of thin iron (which may be called a regulator) is let into a groove made in the board which forms the back part of the hopper.

This cylinder, CY, before the cavities are made, is fixed on an iron axle, LL, one inch square, and turned very true, as well as are those parts of the axle which turn in the collars, or thimbles, fixed in the shafts or handles DD, (Fig. 3.). To the ends of the axle are fixed two wheels WW, twenty-six inches diameter, that turn the axle and cylinder round; which, in passing through the hopper H (filled with turnip seed) bring forward in each cavity a number of seeds, and drop them into the spout P, which are conveyed by it to the coulter C, that forms a channel on the top of the one-bout ridge SD, (Fig. 55.) for receiving them, where S is the channel, and D the dung directly under the seeds.

IF the cavities be made to hold five seeds, when the regulator or tongue is screwed close down, and there be twelve cavities, it will then deposit sixty seeds in one revolution; and as the diameter of the wheel is twenty-six inches, the circumference will be eighty-one and a half; in this case sixty seeds will be deposited in eighty-one inches and a half, or nearly nine in a foot. From this minimum quantity, by screwing up the regulator, the number may be increased gradually to thirty or forty in a foot; which is far too much, unless in very particular and unfavourable situations.

WE shall now give a description of a drill, upon a new construction, for sowing all kinds of grain, in any quantity, and at any distance.

THE inside part of the drill, by which the quantity of seed is regulated, is represented by Fig. 36. where AX is an iron axle, one or one inch and a quarter square, upon which are fixed, at nine or ten inches distance, five, six, or more, brass-fluted cylinders, the flutes being rather more than a semicircle five-eighths of an

inch diameter, or five-eighths wide, and six-eighths deep.

RM are hollow cylindrical rims of hammered iron, which have segments turned down at right angles, to fix exactly the flutes of the brass cylinders; the cavities of which are increased or diminished by the segments of the iron cylindrical rims sliding backwards or forwards in the flutes. This is performed in all the cylinders *at the same time*, by a rectangular space (*n*) being made in the brass cylinders, through which passes a straight piece of iron IN, moving on friction wheels at I, and fastened to the places at LK, and also to the cylindrical rims RM.

LV is a lever, the fulcrum of which is F, and moved by a screw S passing through the frame at V. The end at LK is forked, in which are fixed two friction wheels, made to fit exactly the sides of the collar, or plates of iron JK.

By turning the screw S, the lever moves the whole of the rims at once, and the cavities are increased or diminished at pleasure, and almost instantaneously, to sow *any kind of grain and in*

any proportion, which is shewn upon the scale EOP.

SINCE the first invention of this drill, some improvement and alterations have been made, particularly in hanging the coulters, so as to act entirely independent of each other, and to deposit the seed properly on the most uneven ground;—a drill of this kind, to sow seven rows, is represented in Fig. 37. The seed is conveyed from the cylinder down the tin funnels F, to the coulter CL; this coulter is fixed by a hinge at H, and is kept in its proper position by the iron bar BD, which is fixed to the coulter at C by a bolt, and plays up and down the sloping board EG, to which it is confined by the iron staples SS:—These coulters are easily set to any width of interval, by taking out the staples, and placing them in their proper holes in the slope-board EG; these holes are usually made to answer the intervals of nine, ten and a half, and twelve inches. The hinges H remove with equal readiness to answer the above intervals.

THE iron bars have several square holes in them for inserting spring cotterels, by which any

degree of play is given to the coulters that may be thought necessary.

THE index, or scale, for regulating the quantity, is seen through the arched space at I.

WHEN the machine is drawn by two horses, the shaft-horse is yoked at N, and the other at M; but when drawn by one horse, the bar MN takes off by loosening the screw O, and the shafts are fixed to the middle of the bar, the end of which is seen at H. Any particular row is prevented from sowing by putting in the slots, T; and the whole are prevented from sowing, by a small pinion, N, being detached from another placed upon the nave of the wheel; this is done in an instant by moving the small lever, or key K.

For Turnips—The larger hopper is taken off, and a set of small ones fixed upon the half-egg cavities at the end of the brass cylinders: the quantity is regulated by a tongue screwing up and down, as described in the turnip drill (Fig. 32.)

FOR sowing beans or pease at wide intervals, viz. from twenty-seven to thirty inches, Mr Bailey uses a drill with only one wheel and one cylinder, which a man wheels before him in the furrow, or, what is much better, it may be fixed in the body of a small plough, with one stilt, that passes between the wheel and seed-box, Fig. 38.). By this means the wheel moves along a smooth surface between the land-side and mould-board M, and the seed is deposited at a regular depth: two inches answer very well for beans. With the same small plough and drill I have sown both wheat and barely, at different intervals, from six to twelve inches, and one and a half or two inches deep, with good success; and for small concerns, this cheap and simple apparatus will probably be found the most eligible.

It is fixed to the plough by two pieces of iron going from the ends of the drill; one to the beam at B, and the other to the stilt at C, and, moving round on bolts, allow the wheel W to fall and rise with every accidental hollow or eminence.

MR BAILEY has lately constructed a new turnip drill to sow any number of seeds, from five to fifty or one hundred in a foot, with great precision; and what follows is an accurate description of it.—Vide Fig. 13. 14. 15. 16. and 17.

THE principle is the same as that of the corn and bean drill, viz. a brass cylinder of two inches diameter and two inches long, fixed upon an iron axle of twenty-seven inches long, on the ends of which are fixed wheels of eight feet circumference, (or thirty and one-half inches diameter); the cylinder has eight flutes, two-tenths of an inch wide and one-tenth deep, including the thickness of the copper.

A hollow cylinder of thin copper H, Fig. 13. is exactly fitted to slide upon the solid fluted cylinder of brass A, in which are cut eight oblong holes or slits, with pieces DD turned down at the end, at an angle of forty-five degrees, to fit the flutes, and which increases or decreases the cavities, as the copper cylinder is moved backward and forward by the screw R.

To receive these oblong slips, CCC, the brass cylinder is cut or filed down to the exact thickness and breadth of the copper at BBB, and a little dove-tailed at the edges to prevent their rising; by this means the brass and copper parts form one even surface.

FIGURE 14. is a plan of the wooden frame of this drill, drawn from a less scale. WW are the wheels, AX the axle, C the fluted cylinder, upon which a piece of brass of the form fig. 3. is placed directly over the flutes, the ends are sunk level with the wooden frame at *bb*, and fixed with screw nails; through a hole in this brass the seeds enter the flutes; this hole is made of the form Fig. 16. to act at a wide angle on the edges of the flutes, and prevent the seed from bruising; the box containing the seed is placed upon this brass, and fixed to the frame; the coulter, to which is attached the spout of delivery, is fixed in the hole D; and B is a small iron bolt for fixing the rope by which the drill is drawn.

WHEN the hollow cylinder is screwed close up, if the least number of seeds be 5, and when;

at the greatest extent, the number be 50, then a scale the length the screw moves is divided from 5 to 50, as in Fig. 13. ; by which the attentive cultivator has it in his power to sow any number of seeds between those two numbers, to suit wet or dry seasons, or finely pulverised or cloddy lands.

FIG. 17. Plate 3. represents the form of the flutes.

IN the Northumberland Report, a drawing of a drill to sow one row of beans, peas, &c. fixed to a plough with one stilt is given ; but it being found that the hanging of the weight so much to one side was detrimental to the operations of the machine, it is now contrived to place the drill between the two stilts of the plough, as in Fig. 18.

INSTEAD of the landside stilt being fixed to the end of the beam, and the right hand stilt to the mould-board, as in common ploughs, in this they are fixed as follows. The beam and body of the plough being made as usual, a strong frame of iron **ABCDEF** is fixed upon the beam

GH; and upon the parts BC, AD, of this frame are fixed the stilts ID, KC (represented by dotted lines); the drill PNL is placed in the body of the plough, as represented in the figure, and fixed at the fore-end by the iron bar LM, which moves on a bolt at L, and another at M; and at the hind-end by the iron bolt and bar NO; a plate of sheet-iron, XG, is fixed in the same plane with the landside of the plough, to prevent the clods from falling in and obstructing the wheel W; a plate of sheet-iron is also fixed on the mould-board side to remove the earth, and form a narrow furrow for depositing the seed in; another plate of sheet-iron also passes between this furrow and the wheel.

FIG. 19. represents the frame and drill upon a larger scale. The cavities in the fluted cylinder (being three quarters of an inch wide by half an inch deep) are increased or decreased by the screw R; and their enlargement or diminishment is shewn on the scale S; the diameter of the wheel W is 24 inches; and other dimensions may be had by the scale annexed.

FIG. 20. is an upright view, with the seed-box upon the frame ; GH is the beam ; AD the iron-framing ; ID, KC the stilts ; LM the iron-bar by which the fore-end of the drill is fixed to the plough ; and NO that by which the hind-end is fixed ; U is the spout down which the seed passes to the furrow ; Q is an iron-rod fixed to the fore-end of the frame, by which the wheel of the drill is lifted from the ground, and the sowing or delivery stopped, by hooking it upon the rung R, passing between the two stilts ; by this rod the drill can be stopped or set a-sowing instantaneously. The coulter is bent at V towards the left hand, to bring it into the same plane as the land-side of the plough.

FIG. 21. Plate 4. represents the back part of the hopper XYZ, in which is fixed a piece of brass, UV, of the form of a Gothic arch, which by its oblique position prevents the seeds from bruising.

WHEAT, barley, peas, &c. may be sown with this drill ; for which purpose there is placed at the back of the hopper a regulator TZ, which

is raised or lowered by the screw T, to suit different kinds of grain.

THE drill may be taken out, and the plough used for ploughing the intervals between the rows of beans, peas, turnips, &c.

SECT. VI.

Of a Machine for Reaping Corn.

THE aid furnished to husbandry by mechanical invention has been already noticed; but many people have deemed it practicable to extend that aid to one of the most important branches of rural economy; namely, that of reaping corn, which, at the current rate of labour, is become a most expensive process. This desideratum, however, has not hitherto been obtained, though several unsuccessful attempts have

been made by ingenious artizans to construct an implement capable of executing the reaping process. One of these implements has been constructed by Mr Gladstones at Castle Douglas; and, though found imperfect upon trial, may probably have laid the foundation of a more successful attempt at some future period.

To reap the crop of a large corn farm, since labour became so high priced, proves a burden of great magnitude; therefore, we are disposed to believe that every scheme, which has for its object a reduction of manual labour, by introducing machinery in its stead, must necessarily be favourably received by cultivators of every description, and particularly by those extensively embarked in rural undertakings. We all know what advantage the thrashing machine has proved to the corn farmer; indeed, without this machine, it is probable the expence of separating corn from the straw would, by this time, have amounted to nearly the value of one-tenth of the crop. Be this as it may, as manufactures have reached their present flourishing state entirely through the aid of machinery, there can be no

doubt but that agriculture may be equally benefited by assistance of the like kind. Those who remember the general opinion, when the thrashing machine was first advertised, will not be sceptical concerning the success of a machine for reaping corn; though no doubt the latter, like as it happened to the former, will require many years, and many alterations, before it can be brought to be completely and generally useful.

WITHOUT further preamble, we proceed to describe Mr Gladstone's machine; see Fig. 39. 40.

AA are the shafts in which a horse is yoked. BB are two wheels, which support the machine, and, revolving upon the ground when the horse goes forward, give motion to the machine. Upon the axle C of the wheels, the large cog-wheel D is fixed, acting in the pinion E; upon the axle of which is fixed the breast-wheel F, and the pully G. The breast-wheel F, by acting in the pinion R, gives motion to the breast-wheel H. The cutter K is fixed on the lower end of a spindle, coming up through the middle of the iron bar LLL; and upon the top of this spindle the small

pinion M is fixed, which acts in the breast-wheel H.

THE pulley G, by means of a pitch-chain, sets in motion the small pinion N, which acts in the large gathering wheel O; and on this wheel the large cross-arm PP is fixed, to the one end of which the gatherer Q is attached, with another gatherer at the end of it, if found necessary. The gathering wheel O, with its cross-arm PP, and gatherer Q, revolves round the cast-iron bar LLL, as its centre or axis.

It is evident, when the machine is drawn forward, the cutting wheel K will be put into a very rapid motion, while the gathering apparatus will go comparatively slow. SS is a circular table of wood, with strong wooden teeth, notched below all around, in front of it. The table is fixed upon the cast-iron bar LLL; and, as the cutter works immediately below, or rather betwixt the wooden teeth, as may be seen at T, they not only hold the corn from flying the cutter, but prevent it from being hurt or damaged; and the table serves to support the corn when cut till the gatherer comes round.

W is a spindle through the cross-arm P ; a tail V is fixed to the bottom of it ; and the gatherer Q, fixed to the top of this spindle, has liberty to turn backward and forward upon it as a centre. W is a segment of wood, by which the tail and gatherer are supported. This tail keeps the gatherer in its proper position, until it comes round below the large cross-beam X. A piece of wood is fixed below this beam, which takes the corn out of the gatherer, and leaves it in small sheaves or handfuls. This it does easily ; as the tail of the gatherer being no longer supported by the the segment of wood W, the gatherer falls back, and continues in the position, as at M, till it comes round to N, when the tail rests on the piece of wood W, and brings the gatherer again into its proper position. The gatherer can be let out and taken in, as necessary, by means of the slide groove seen at W. *aa* are small circular pieces of wood, coated with something that has a tendency to make iron sharp by rubbing upon it ; but the name thereof I have forgotten. These circular pieces of wood are put into a rapid motion by the rope *b*, over the pulley *c* and *d*. They are so constructed as to be put in motion

and stopped at pleasure, without interrupting the progress of the machine. They also sharp the edge of the cutter. w is a small handle, which turns a screw, that sets the pinion E out of the large cog-wheel, and admits the machine to be drawn as easily as a common cart, without putting the machinery in motion. $g g$ are two handles, by means of which the cutter can be made either to cut low or high, as circumstances may require.

FIG. 39. gives a side view of the machine ; Fig. 40. a horizontal view of it ; Fig. 41. is a view of the cutting-wheel by itself, with separate cutters or scythes bolted to it, as at $n n n n n$; Fig. 42. is a view of the cast iron-bar LLL ; and Fig. 43. is a view of the cutting wheel. I am well aware of the difficulty which attends a description of this nature, and how imperfectly it may be understood by the great body of those who are interested ; but if I have made myself intelligible to mechanics, or such cultivators as are tolerably well acquainted with the first principles of the art, my object will be completely gained.

WE may add, that several years have elapsed since Mr Gladstones constructed the main parts of the machine which we have attempted to describe ; and, about two years ago, he made a model thereof, which was mentioned to the Highland Society by Sir Alexander Gordon, Bart. That respectable body at first seemed anxious that Mr Gladstones should construct a complete machine, so as its power and uses might be sufficiently ascertained ; but latterly, for reasons best known to themselves, their support has been withdrawn ; and the design likely would have been given up, without bringing it to a completion, had not a public spirited gentleman, Sir Edward Crofton, seen the model, and ordered a machine to be made on his account.

THOUGH the machine constructed for Sir Edward Crofton was defective, we understand that Mr Gladstones has lately made several improvements upon his original design, which ultimately may render it more perfect. That respectable body, the Dalkeith Farming Society, have also taken up the subject ; and a complete machine is now making, at their request, by Mr Alexander Scott, Ormiston, according to the principles of

a model which had previously obtained their premium.

SECT. VII.

Of Thrashing Machines.

WE now come to treat of the Thrashing Machine, the most valuable implement in the farmer's possession, adding more to the general produce of the country than any invention hitherto devised. The saving of manual labour, thereby obtained, is almost incalculable; while the work is performed in a much more perfect manner than was formerly practicable, even when the utmost care and exertion were bestowed. In fact, had not the thrashing machine been invented, it is hardly possible to conceive what would have been the rate or expence of thrashing, or even whether a sufficient number of hands could, at

any rate of expence, have been obtained for thrashing the grain of the country. Thrashing was always an unpopular branch of work, and seldom undertaken where other jobs could be procured. If this was the case in former times, when hands were more plentiful than work, what would have been the case now, when the labour of the country exceeds the means by which it is to be executed? Either corn would have remained unthrashed, or the charge of doing it would have greatly diminished the profits of the farmer, and consequently the value of land would have been considerably affected.

NOTHING caused so much loss and vexation to the farmer in former times as the process of separating corn from the straw; and various methods, in different ages, were adopted for accomplishing this operation. The ancient inhabitants of Asia and Egypt, where agriculture is supposed to have had its origin, knew no other method than that of inclosing a spot in the open air, and smoothing it with clay rolled hard; this was the thrashing floor. The corn being next spread in sheaves, oxen were turned in, and kept in motion till the business was done. "Thou

shalt not muzzle the ox that treadeth out the corn." Deut. xxv. 4.

IF Ælian may be believed, the Greeks were neither so merciful nor cleanly in this circumstance. They besmeared the mouths of the poor animals with dung, to keep them from tasting the corn under their feet. *Hist. Animal.* lib. iv. cap. 23.

MACHINES were next invented, in different countries, made of planks or beams, stuck over with flints or hard pegs, to rub the ears between them; others to bruise out the grain by sledges, or trail-carts.

*Dicendum et quae sint duris agrestibus arma
Tribula, trabaeque, et iniquo pondere ratri.*

THE translators of Virgil, from Father Ogilvie downwards, have included the flail in this description:

The sled, the tumbril, hurdles, and the flail.

DRYDEN.

TRIBULUM, however, was certainly the machine first described for the single purpose of separating the grain from the husk, or chaff. At what period of time the flail took place of the former awkward machine is not known with certainty. President Goguet says, that the Turks, and many of the Italians, have not yet adopted it. The barbarous Celts, accustomed to fire and sword, made short work. They burned the straw, and instantly devoured the grain; and, it is said, this custom continues amongst their descendants in some parts of the Highlands of Scotland to this day.

IN Britain, till 1787, the flail was the only instrument employed for separating corn from the straw. But, previous to that period, several attempts were made to construct machines for performing that laborious work. The first attempt was made by an ingenious gentleman of the county of East Lothian, Mr Michael Menzies, who invented a machine upon the principle of driving a number of flails by a water-wheel; but, from the force with which they wrought, the flails were soon broken to pieces, and consequently the invention did not succeed.

ANOTHER thrashing machine was invented about 1758, by Mr Michael Stirling, a farmer in the parish of Dumblain, Perthshire. This machine was nearly the same as the common mill for dressing flax, being a vertical shaft with four cross-arms, inclosed in a cylindrical case, three feet and a half high, and eight feet diameter. Within this case, the shaft with its arms were turned with considerable velocity by a water-wheel, and the corn being let gradually down through an opening on the top of the box, the grain was beat off by the arms, and passed with the straw through an opening in the floor, from which it was separated by riddles shaken by the mill, and then cleared by fanners, also turned by it.

BUT the machines which first attracted public notice were those erected in 1772 and 1773, in Northumberland, by Mr Ilderton at Alnwick, and Mr Oseley at Flodden. Mr Ilderton's acted upon the principle of pressing or rubbing out the corn by a large drum. Mr Oseley's attempt had the appearance of being more successful; therefore the nature of his machine shall be described with some minuteness. This we are partly induced to do, because some people have alleged

that the machine, now in general use, was copied from it. This however is not true; for we are confident that Mr Meikle never saw or heard any thing of it till a long time after it was taken down. Indeed, a moment's consideration may satisfy any one acquainted with mechanics, that these machines were constructed upon different principles, and that in practice the operations of each were as different as the principles.

THE machine erected by Mr Oxley, for Sir John Delaval, Baronet, had two fluted rollers, and, in place of a drum, had a double set of arms which were connected at the ends by cross bars. The scutchers were framed of two pieces of wood about three inches broad, one and a half inch thick at one end, by three quarters of an inch at the other, and were connected with the cross bars by leather straps. A circular breast was fixed beneath the centre about three inches from the scutchers, so as to allow the corn to pass betwixt them; and the unthrashed corn was laid upon a board at the level of the centre of the scutchers, and drawn in by two fluted rollers. The operations of the machine were very defective; and as little corn could be passed at

a time, the expence of thrashing was greater than when executed by the flail.

THE principles upon which the machine was constructed were evidently erroneous. The form of the scutchers, and the way in which they were fixed, were such, that their reverberations necessarily weakened the force of the stroke so much as to require an exertion of greater power. To give extra power however was impracticable, for if one half of the velocity required by the machine now in use had been given, the scutchers would instantly have been broke to pieces, and occasioned the destruction of the machine, besides endangering the lives of the people employed in working it.

FROM these circumstances it may be deduced that velocity formed no part of the principles of this machine, and that it could not have been successfully used without being materially amended. But this is not all. The relative situation of the feeding rollers and scutcher was such, that the utility of the former was in a great measure defeated. The purpose of the rollers is to draw the corn gradually forward, and to hold it

firm when the shake of the scutcher is given ; but the distance betwixt them and the scutchers prevented the latter from being accomplished. Another important defect was the want of a drum, a part of the implement absolutely necessary to prevent the corn from flying about the house, and the straw and chaff from clogging the machinery, to which the scutchers were suspended. The abandonment of the machine, after it was tried, however, proves its inutility in a stronger manner than the most satisfactory human testimony.

MR OSELEY'S machine was never made public; therefore it is proper we should explain how the above particulars were obtained. They were communicated to us by a mill-wright at Newcastle, who assisted in taking the machine down after its inefficacy was ascertained ; and, being corroborated by the information of others, may be fully relied upon.

HAVING thus detailed some of the laudable, though unsuccessful, attempts to construct machines for thrashing corn, we come to narrate the circumstances which led to the construction

of the machine now in general use. Every former attempt having failed, unquestionably the merit of the invention belongs to the gentleman shortly to be mentioned.

THE late worthy Sir Francis Kinloch of Gilmerton, Baronet, who it is well known possessed a large stock of mechanical knowledge, in one of his tours, happened to see the machine erected by Mr Ilderton upon his farm near Alnwick, and ordered a model thereof to be made for his use, which we believe was executed by the late Mr Rastrick at Morpeth. Sir Francis made many improvements upon Mr Ilderton's design; and several models executed by him, or at least under his inspection, are still preserved; one of them tolerably perfect, we have seen in the ware-room or depot of the Board of Agriculture in London. As Sir Francis had no opportunity of trying a large model which he caused to be made, it was sent by him to Mr Andrew Meikle civil engineer at Houston mill, in the county of Haddington, that its effects might be ascertained by the water-wheel of Mr Meikle's barley mill. The trial was accordingly made; but in a few minutes the model was torn to pieces; and the

like fate befel a machine of full size, which Sir Francis erected for one of his tenant's a few years afterwards. In short Sir Francis' machine, like that of Mr Oseley, was incapable of sustaining the velocity required in thrashing, therefore was not imitated by a single person. A great deal of praise however is due on account of the attempts which he made to construct a machine capable of separating corn from the straw. The way to success was certainly opened and paved by Sir Francis and other people; and while justice is done to their attempts, the merit of the man who first constructed a machine of sufficient strength and powers for performing the work of thrashing in the completest and most satisfactory manner, is not thereby lessened.

MR MEIKLE, after trying Sir Francis Kinloch's model, was induced to turn his attention to the subject of thrashing by machinery; and a principle occurred to him, entirely a new one, because it had not been previously acted upon by any other person. It is evident that the power required to thrash corn in a perfect manner, or even in any quantity, must be considerable, as it is now completely ascertained, that to do the work

right, a machine must move with a velocity of two thousand feet of the circumference of the drum in a minute. Reflecting upon this circumstance, Mr Meikle thought that the surest way of executing the work was *to beat out the corn from the ear by means of a strong drum or cylinder, upon which fixed beaters shoed with iron should be placed.* Experience sanctions the justice of this principle; for almost every machine now in use has been copied from those he first erected; though, no doubt, many variations upon the size of the drum, and other parts of the implement, totally distinct and unconnected with the original principles, have been adopted by him and others. It may be added, that the machine is capable of being safely wrought with greater velocity than what we have mentioned; and it is already said, without considerable velocity corn cannot be thrashed in a satisfactory manner.

THE first machine erected by Mr Meikle, was on account of Mr Stein at Kilbeggie, in Clackmannanshire. A sure proof that such a machine was then altogether unknown may be gathered from the agreement about this erection; it being therein stipulated that Mr Stein was to

furnish the materials; and that if the machine did not answer the intended purpose, Mr Meikle was not to receive any payment for the work performed. This machine being successful, another was erected for Mr Seley at Middleton in Northumberland, which was immediately copied and imitated by several mill wrights of that county; one of whom had the singular modesty to claim the invention, because he had previously made a model of Mr Ilderton's machine,—a machine of a quite different nature, though intended to perform the like operation.

THE utility of the machine being satisfactorily ascertained, a patent for the invention was obtained by Mr Meikle. It is a singular circumstance, that though this patent was obtained at considerable expence, it was not acted upon in the first instance, though, at that time, it would have been an easy business to have carried it into execution. At a future period, viz. when ten years of the patent were expired, some of Mr Meikle's friends stood forward, and endeavoured to put it in force; but the interlopers were then so numerous, that the design could not be executed without risking an excessive expence, nor

he be compensated by any profits that could be gained during unexpired years. Thus the worthy inventor has hitherto derived small benefit from an invention which has profited the public more than any other implement yet devised; though, it is recorded with pleasure, that a subscription among proprietors and occupiers of land is now going on for rewarding him, which from present appearances promises to be ample and sufficient.

Since the invention of the machine, various improvements have been introduced by Mr Meikle and others, all tending to simplify the labour, and to augment the quantity of the work performed. When first erected, though the corn was equally well separated from the straw, yet as the whole of the straw, chaff, and corn, were indiscriminately thrown into a confused heap, the work could only, with propriety, be considered as half executed. By the addition of rakes, or shakers, and two pair of fanners, all driven by the same machinery, the different processes of thrashing, shaking, and winnowing, are now all performed at once, and the corn immediately prepared for the public market. When it is added,

that the quantity of corn gained from the superior powers of the machine is fully equal to a twentieth part of the crop, and that, in some cases, the expence of thrashing and cleaning the corn is considerably less than what was formerly paid for cleaning it alone, the immense savings arising from the invention may at once be ascertained.

Where farms are of a small size, it would be improper to recommend the erection of large machines, as the interest of the original outlay would be a heavy drawback from the advantages; but, under contrary circumstances, we are decidedly of opinion, that a machine of great powers, provided with two rakes, or shakers, and two pair of fanners, is the most profitable one for the possessor. By such a machine, when wrought by horses, the grain is completely thrashed and cleaned at little more expence than is paid for cleaning it alone, when thrashed by the flail, independent of the additional quantity of corn produced; and, when wind and water is substituted instead of horses, the saving is considerably increased.

A horse machine of the greatest powers, with the appendages of rakes and fanners, may be erected for L.150, and, when wrought by wind, for L.300, independent of the buildings and fixtures which are required. It would be unfair, however, to charge these articles of expenditure to the account of the thrashing machine, as, even on a middle-sized farm, a much greater extent of building is required for barn-work, when the corn is separated from the straw by the flail, than when the operation is performed by the thrashing machine.

FROM the most minute attention bestowed on this subject, we are confident that an extra quantity of corn, equal, in ordinary years, to 5 per cent. will be given by the thrashing machine, above what is obtained by the flail; besides innumerable other advantages which accompany that machine. Indeed, the best of farmers were obliged to submit to losses by the flail, because they could not be remedied; but, with the thrashing machine, no corn need be lost, as every particle of grain is scutched off, when the machine is constructed upon right principles.

THE expence of horse-labour, from the increased value of the animal, and the charge of his keeping, being an object of great importance, it is recommended that, upon all sizeable farms, that is to say, where two hundred acres or upwards of corn are sown, the machine should be wrought by wind, unless where local circumstances afford the conveniency of water.

WIND machines were, till lately, exposed to dangerous accidents, as the sails could not be shifted when a brisk gale suddenly arose, which is often the case in the variable climate of North Britain. These disagreeable circumstances are now effectually prevented, by the inventive genius of Mr Meikle ; and the machine may be managed by any person of the smallest discernment or attention.

THE whole sails can be taken in, or let out, in half a minute, as the wind requires, by a person pulling a rope within the house, so that an uniform motion is preserved to the machine, and the danger from sudden squalls prevented. Another person has even improved upon this invention ; and these machines are now constructed in such

a way as that they can be reefed and unreefed by the operation of machinery. Those recently erected are also guided or pointed to the wind by a small wheel or helm, and, in short, have reached to a degree of perfection that could hardly have been expected to take place with such implements.

WHERE coals are plenty and cheap, steam may be advantageously used for working the machine. A respectable farmer in the county of East Lothian, works his machine in this way; and, being situated in the neighbourhood of a colliery, he is enabled to thrash his grain at a trifling expence.

THE quantity of grain thrashed in a given time must depend upon its quality, on the length of the straw, and upon the number of horses, or strength of the wind, by which the machine is wrought; but, under favourable circumstances, from seventy to eighty bushels of oats, and from thirty to fifty bushels of wheat, may be thrashed and cleaned in one hour. But it is from clean dry grain only that so much will be done in that period.

As a farmer's capital ought never to be laid out in expensive building, or works of an extraordinary kind, we are of opinion, that the sums necessary for erecting machines should, in the first instance, be expended by the landlord, and the tenant bound to leave them in a *workable condition* at his departure. Many farmers have capitals sufficient for undertakings of this kind; but the great body of that profession would be injured by such an expence, as they would thus be deprived of the means of improving their farms in other respects. Besides, as every improvement, at the long run, centers in the pocket of the proprietor, it is but fair and reasonable he should contribute his moiety of the expence laid out in procuring it; and, in many cases, he would be benefited, in the first instance, by the erection of thrashing machines, particularly where new farm-steadings are to be built, as fewer buildings would, of course, be necessary.

WE have said that the thrashing machine is the most valuable rural implement hitherto invented, and shall now offer some calculations in support of what we have maintained. It is understood that the extent of ground devoted an-

nually in Britain to the culture of corn amounts to eight millions of acres ; therefore, taking the average return at three quarters per acre, as below that increase corn cannot be cultivated with profit, the total amount of corn produced annually within this island would be twenty-four millions of quarters ; a quantity not exceeding what is required for supplying the consumption of the inhabitants and other purposes. Now, as it is well known that the thrashing machine, from its superior powers, will give one-twentieth more grain than when the operation of thrashing is performed by the flail, this furnishes an increased quantity of one million two hundred thousand quarters, which, estimated at the low average price of forty shillings per quarter, amounts in value to two millions four hundred thousand pounds Sterling. Add to this the difference of expence betwixt thrashing by the machine and the flail, which, in general cases, may be stated at one shilling per quarter, it will appear that, if the whole corn raised in Britain was thrashed by machines, the saving to the public would not be less than three millions six hundred thousand pounds Sterling annually. Suppose one-half, or even one-third, of British grain only thrashed in that

manner, still the saving thereby is an immense one. Those who may doubt the accuracy of these calculations are requested to try them by facts ; and we are much mistaken if the result will differ very materially from what is here stated.

IN the foregoing account we have given the merit of inventing the thrashing machine solely to Mr Meikle, and, upon looking over what is stated, we see no cause to retract one word of what is maintained. We are perfectly aware that many people besides Mr Meikle attempted to construct such machines, but contend that every one of these attempts was abortive, and that all the machines erected upon principles different from those fixed on by Mr Meikle have, with the exception of Mr Stirling's, been renounced and forsaken. Those who dispute this statement are bound to condescend upon the machine or machines that were erected prior to the one which Mr Meikle put up for Mr Stein, Kilbeggie ; and, if they cannot make such a condescendence, must acknowledge that the honour of the invention belongs to Mr Meikle. That other people attempted to construct thrashing machines

before Mr Meikle made a perfect one we have already acknowledged ; and we may add, that those who engaged in such attempts were and are entitled to much praise on that account : Still the merit of the actual invention is not thereby lessened ; on the contrary, it is rather increased, seeing that he proved successful in a cause where many others had previously failed. Let us put a case, and it is one exactly parallel. Some years ago, Mr Gladstones at Castle Douglas laudably endeavoured to construct a reaping machine, but was unsuccessful ; others did the same, and with no better success. Now, Mr Scot at Ormiston has lately obtained a premium from the Dalkeith Farming Society for the best model of a reaping machine, and is now constructing a full-sized implement according to the principles of that model. Should Mr Scott be successful, must not he be considered as the inventor of the reaping machine, notwithstanding that Mr Gladstones, and many others, were previously working at such implements ? Of this there can be no doubt. Let the case be reversed. Sir Francis Kinloch, or any other person, being substituted for Mr Gladstones, and Mr Meikle

for Mr Scott, and let any one say why a similar judgment should not be pronounced.

IN a word, the invention of this implement may be considered as the greatest improvement that has been introduced into Britain during the present age. The toil of human labour is by this means lessened, the stock of agricultural produce is greatly increased, and the facility of managing large concerns wonderfully promoted. The duty of rewarding the inventor is a debt incumbent upon the whole landed interest of the island, and, by discharging it, they will stimulate ingenious mechanics of all descriptions to exert their talents in making useful discoveries.

SMALL machines are used for thrashing in many places; but we have doubts respecting the advantages of such implements. Allowing that the work is equally well performed with a small machine as with a large one, still it is unquestionably true, that the expence of thrashing must be greater when the former is employed; because the time of one person must be occupied in feeding the machine, whether one boll or ten bolls of grain be thrashed within the hour. This

is an objection to small machines, which cannot be gotten over, even were it allowed that the grain is equally well thrashed ; a circumstance concerning which we have considerable doubts. It is one of the defects, however, which attend small farms ; for it is almost impossible upon them to make a suitable division of labour in any case. The best machine is that which is impelled by a six-horse power ; because such a machine is well qualified to thrash every kind of grain perfectly, while, at the same time, full employment is given to the feeder. On small farms, we have always considered the flail to be the most profitable implement for thrashing grain ; because the expenditure incurred in erecting a suitable machine would exceed the probable benefit. Perhaps thrashing machines can rarely be worked with advantage upon a farm where less than one hundred acres are annually cultivated ; and it is evident, without demonstration, that the benefit of using them is in direct proportion to the quantity of corn that is cultivated. If we shall suppose, that the interest upon outlay and the tear and wear of a thrashing machine is fifteen pounds *per annum*, and that 800 bolls of grain are raised where 100 acres are cultivated, the charge, on

accounts is precisely fourpence-halfpenny per boll. If the farm is of such a size as to admit the raising of sixteen hundred bolls, the charge is reduced to twopence-farthing per boll; but, should the return amount to two thousand four hundred bolls, the charge will be no more than three halfpence per boll. This is a true view of the business, when interest on outlay, tear and wear are to be considered; and proves, what has seldom been questioned by those who have studied the science of rural economy, that a large farm may be managed comparatively at much less expence than a small one.

THE scarcity of labourers in many districts, owing to the increase of trade, and the immense number of hands employed in the army and navy, furnishes another argument for the general introduction of thrashing machines. It is a circumstance which cannot fail to excite surprise, that those machines are scarcely known in many of the best cultivated English counties, notwithstanding that their utility is universally acknowledged wherever they have been erected. Some objections have been offered by English farmers, as if the saving in one way would be compensated

by the increased expence in another ; in other words, that if thrashing machines were brought into general use, a great many labourers would be thrown out of employment, which, of course, would serve to raise the poor rates. Experience, however, is, in every case, the surest guide. The very same argument was used in Scotland when machines were introduced ; and yet it has been found that the savings made by the farmer in this way enabled him to employ more labourers than before. A similar objection was urged against two-horse ploughs at their introduction, as if these implements would prevent young men from being trained to husbandry, and cause the number of ploughmen to fall below the actual demand. Time has, however, shewn the weakness of these objections. Ploughmen are as plentiful as formerly ; and, what is of greater importance, they are better qualified for executing their work. Every invention that lessens the expence of farm labour enables the farmer to employ additional hands in carrying on other works ; and, in all improved farms, these works are so numerous, that employment can never be wanting for labourers, as long as the means of paying them remain with the employer.

THE mode of harvesting corn in England, however, is much against the use of thrashing machines; and indeed it is against the process of thrashing in whatever way it is performed. In many counties, all the grain, with the exception of wheat, is cut by the scythe, and of course is not bound up into sheaves in that regular way as when it is cut by the sickle. Oats, in particular, cannot be thrashed clean with a machine, unless the heads or ears are fairly and equally exposed to the beaters or scutchers. If either this grain or wheat passes irregularly or unequally through the feeding rollers, the beaters have little power, and are unfit for accomplishing the process of separation. Barley and beans are grains more easily thrashed; the latter especially, than wheat and oats; though, after all, the more regular that unthrashed grain is presented to the machine, so much the more completely will the grain be separated from the straw.

IN the above account, Mr Menzie's attempt to thrash grain by the use of a machine is slightly noticed. Though the attempt was unsuccessful at the time, there is no doubt that it afterwards

proved of public benefit; because the attention of ingenious artizans was thereby turned to the same subject, till at last a perfect machine was constructed. The like result, we hope, may follow the attempts of artizans to construct reaping machines; and though these attempts have hitherto been unsuccessful, yet, when it is considered that the long period of forty years intervened betwixt the commencement and completion of the thrashing machine, or, at least, before a perfect one was constructed, there is no cause for despairing of a proper reaping machine being in time obtained, notwithstanding the failures that have already occurred.

NOTWITHSTANDING that Mr Menzies's machine did not answer the intended purpose, we think it right to give the following description of it as contained in a report made to the Edinburgh Society of improvers by two of its learned members. Much praise, in our opinion, was due to Mr Menzies.

“ Mr Michael Menzies, advocate, having invented a machine for thrashing of grain, and obtained a patent for the sole disposal of it, upon

a representation made to the Society, that it was to be seen going in several places, and that the said machine saved labour, and thrashed the grain cleaner than the ordinary way, they appointed Mr Alexander Boswel and Mr Charles Maitland, advocates, to visit it, make their observations and remarks thereupon, and to report.

“ *THEIR Report.*—In obedience to the appointment, we went to Roseburn, near Edinburgh, where one of the machines is set up, and is moved by water. We were there a considerable time, and examined, with all the exactness we could, the structure thereof. Thereafter we saw it thrash for some time; and that the power and exactness of it might the better appear, straw, that seemed to be well thrashed before, and to be as clean of grain as straw thrashed in the common way generally is, was put into this machine; and out of twelve bottles of this straw there was thrashed very near the fourth part of a peck; and the grain, thus thrashed out, was good, and no ways bruised or hurt. After we had seen the large machine, which is moved by a great water-wheel and triddles, we went and

saw another, which is moved by a little wheel of three feet diameter, acted upon by a small quantity of water; which last would be useful, where there is not conveniently to be had a sufficient quantity of water for moving a large wheel, and might serve almost at every place in the winter time, being supplied from the small currents occasioned by the land-floods. And it is our humble opinion, that the machine would be of great use to farmers, both in thrashing the grain cleaner from the straw, and in saving a great deal of labour; for one man would be sufficient to manage a machine, which would do the work of six; and that therefore the Society should recommend the use of the same, and give all the encouragement they can to so beneficial an invention, which, being simple and plain, in the machinery, may be of universal advantage.

“ The Society approved of the report, and recommended the said machine to all gentlemen and farmers.”

THE ingenious Mr Bailey gives an excellent description of the thrashing machine, in the *Northumberland Survey*, which, with the great-

est liberality, he allows us to use on the present occasion.

A Description and Calculation of a Thrashing Machine erected at Chillingham.

“ IN Fig. 44, **BB** is a horizontal board, or table, five feet long by three feet four inches broad, on which the corn **CC** is *evenly spread*, and presented to the cast-metal fluted rollers **RR** (four inches diameter), which take it regularly in, and by their weight and sharp edges hold fast the straw, while it is struck, switched, or thrashed, by the switchers, or pieces of wood **SSSS**, fixed in the cylinder **DD**, and projecting three inches from its surface * ; these, when they

* This cylinder is made with strong arms, on which are fixed the switchers, and cased round with narrow inch deals, the whole secured from flying off by strong iron hoops, surrounding them at each end. The switchers are covered with plate iron, to prevent their wearing.

strike the corn, move in an upward direction **RE**, with great velocity, and throw the corn as it is thrashed, and the straw as it leaves the fluted rollers, against the circular rake **KK**, and upon the wire skreen **G**, from whence the straw is taken by the rake, and delivered upon the sloping board **L**, down which it slides to the floor **N**, while the corn passes through the skreen **G** into the hopper **H**, and from thence to the inclined board **I**; but, in falling from **H** to **I**, a strong current of air, raised by the fanners **FFF**, blows the chaff over the sloping board **O**, and the light corn against it, which falls into the space **P**, and the chaff into **M**, while the good grain slides down the inclined board **I I** to the floor at **Q**, from whence it is taken and put into a second winnowing machine, in which are placed proper riddles to suit different kinds of grain. This second machine is moved by a rope going over a pulley fixed in the axle **T**, and is set a-going, or stopped, at pleasure, by a stretching pulley, as occasion requires.

WHERE the situation will admit of the board **I I** being placed about four feet from the floor, the second winnowing machine may be placed

directly under it, and save the trouble of lifting the corn.

To find the velocity of the particular parts, we must divide the product of the number of cogs in the *driving wheels*, by the product of the number of cogs in the *driven wheels*, and the quotient will be the number of revolutions made by the last moved part, for *one* of the first moving part.

THE whole is put in motion by an overshot water wheel fourteen feet diameter, which makes from five to six revolutions per minute, according to the supply of water. On the axle of this water wheel is fixed a large spur wheel *aa* of 160 cogs ($152\frac{3}{4}$ inches diameter), which drives a cast-metal pinion *b* of 16 cogs (15.28 inches diameter), on the axis of which is placed another spur wheel *c* of 63 cogs (60.1 inches diameter), that drives the cast-metal pinion *d* of 16 leaves (15.28 inches diameter), on the axis of which is fixed the cylinder DD (four feet diameter, and five feet long), with the four projecting pieces of wood, or switchers, SSSS, that switch or thrash the corn, as described above.

THEN $\frac{1}{8}^\circ \times \frac{6}{1} = 39.375$, the revolutions of
 the cylinder for
one of the water
 wheel,
 which multiplied by 5.5, the medium re-
 volutions of the
 water wheel per
 ——— minute,
 gives 216.562, the revolutions of
 the cylinder per
 minute;
 this multiplied by 4, the number of
 ——— switchers,
 gives 866.25, the number of
 strokes per mi-
 nute.

And, as the diameter of the cylinder is four
 feet, the circumference will be 12.56;
 therefore 216.5625, the revolutions of
 the cylinder per
 minute,
 multiplied by 12.56 feet, the circum-
 ference of the cy-
 ——— linder,
 gives 2720 feet, the velocity
 of the switchers
 per minute.

THE large spur wheel *a* also drives the light cog wheel *e* of 63 cogs (60.1 inches diameter), fixed on the axis *k l* of the rake for taking away the straw.

THEN $\frac{16}{63} = 2.54$, the number of revolutions which the rake makes for one of the water wheel,
 multiplied by 5.5, the revolutions of the water wheel per minute,
 gives 13.97, nearly 14, the revolutions of the rake per minute ;
 which, having four arms, will clear the skreen of straw 56 times per minute.

THE rollers are moved by the pinion *b* of 16 leaves, working into the slight cast-metal wheel *f*, fixed on the iron axis *i i* of the lower roller, on which axis is also fixed a small pinion *g* of eight leaves, working into another *b* of equal number, fixed on the axis * of the upper roller,

* This axis is fixed into the upper roller, either by an universal joint, or with a square tapering end, to

which gives the two rollers an equable motion for taking in the corn.

THEN $\frac{1}{8} \times \frac{1}{8} = 4.444$, the revolutions of
the rollers for *one* of
the water wheel,
multiplied by 5.5,
gives 24.44, the revolutions of
the rollers per mi-
nute,

AND the diameter of the rollers being four
inches, the circumference will be 12.566 inches ;
therefore 12.566 inches, the circum-
ference of the rol-
lers,
multiplied by 24.44, the revolutions of
the rollers per mi-
nute,
gives 3071 inches of straw, pas-

allow the upper roller to rise and fall, according as the corn is fed in thicker or thinner, and the concave board RE is hung on a bolt, to allow it to rise and fall with the roller.

sing through the rollers per minute ; which 307 inches receive 866 strokes of the switchers in that time, or nearly three strokes to an inch.

WHEN the rollers are required to move swifter or slower, they may be driven very conveniently from the end of the axle of the rake, by fixing a cast-metal *faced wheel* on it, with three rows of cogs, (8, 10, and 13), working into a shifting pinion of eight leaves, fixed on an iron axle ; at the other end of which is put a small *bevel wheel* of 12 teeth, working into another of eight teeth, at the end of the axle of the lower roller.

THE *fanners* are moved by a *crossed rope*, passing over a pulley T, 10 inches diameter, fixed on the axis of the cylinder, and another V of eight inches diameter, on the axis of the fanners. Then, as the axis of the cylinder makes 215.66 revolutions per minute, we have $215.66 \times \frac{10}{8} = 270.7$ revolutions of the fanners per minute.

FROM the above it appears, that when the water wheel makes $5\frac{1}{2}$ revolutions in one minute,

The cylinder will make	$216\frac{1}{2}$	ditto,
The rollers	$24\frac{1}{2}$	nearly,
The rake	14	ditto, and clears the skreen of straw 56 times per minute,
The fanners	$270\frac{3}{4}$	ditto,
The switchers make	866	strokes per minute, and move with a ve- locity of 2720 feet per minute.

THE rollers take in nearly 300 inches of corn per minute. The medium length of good oats is about 30 inches; and, supposing half a sheaf put in at a time, a whole sheaf will then be equal to 60 inches: Therefore $\frac{300}{60} = 5$ sheaves per minute, which agrees with the usual rate of going of this machine, when supplied with a *medium* quantity of water. From some experiments lately made, 120 sheaves of oats were thrashed in 29 minutes, and yielded 12 bushels, which is at the rate of 33 bushels per hour, or 264 per day of eight hours.

THE expence, for the attendance of the thrashing and dressing part of this machine, is only

that of three women; viz. one to feed-in, another to hand the sheaves to the feeder, and the third to take away and riddle the corn after it is winnowed: of course, the expence of thrashing and dressing 264 bushels is only 1s. 6d.

THE expence of thrashing the same quantity by the flail would be one twenty-fifth part, or ten and a half bushels, which, at 2s. per bushel, is 21s. to which must be added 2s. the expence of a man and two women to assist in winnowing, making in all 23s.

THE expence of erecting a thrashing machine of this kind was from L. 70 to L. 80; but since the advance of wood, iron, and wages, it will be now near L.100.

Machines of small dimensions are erected for about L. 50, which, with two horses, will thrash and dress 120 bushels of oats, or 60 of wheat, in eight hours.

ROLLERS, or small *millstones*, are added to many of these machines, for crushing or grinding grain for horses, swine, &c. Knives for cut-

ting straw, and many other useful appendages, might be added.

IN Virginia, and other countries, wheat is trodden out by horses, nearly in the same way as it was formerly done in Palestine by oxen. A short account of this practice cannot be unacceptable to our readers.

THE treading floors are generally from sixty to one hundred feet diameter; but the larger their diameter is, so much easier is the work to the horses. The tract, or path, on which the sheaves are laid, and on which the horses walk, is from twelve to twenty-four feet wide, or more. The floors are commonly inclosed by fences; and the horses are generally driven between them promiscuously and loose, each pressing to be foremost, so that fresh air may be obtained,—biting, jostling, and kicking each other with the greatest fury. The labour is this way in extremely severe. Upon some small floors, a centre stick is placed, to which hangs a rope, or a pole and swivel, and four or five horses being fastened together, travel round upon the sheaves with the utmost regularity. Previous to laying down the wheat sheaves,

the state of the air, and the probability of its continuing dry through the day, is fully considered. If they resolve to tread, the morning is suffered to pass away till the dew is removed. A row of sheaves is first laid upon the floors with the heads and butts in a line across the track of it, as a bolster for receiving other sheaves; and these sheaves range with the path, or circle, the butts resting on the floor. Other sheaves are ranged in like manner, with the heads raised on the former, till the whole floor is filled, when it appears to be filled with nothing but ears of wheat, sloping a little upwards. Upon laying down each sheaf, the band thereof is cut with a knife. A west wind is always desirable while treading is going on, as when wind is from the eastward, dampness generally prevails.

IN some instances, twenty-four horses are formed at some distance from the floor into four ranks; and when the floor is ready laid, the word is given to advance. For the sake of order and regular work, a boy mounted on one of the foremost horses advances in a walk with the whole rank haltered or tied together, and en-

ters upon the bed of wheat, walking the horses slowly over it; another rank is ordered to follow as soon as the first is supposed to have obtained a distance equal to a fourth part of the circumference of the bed, and in the same manner the other ranks proceed. They are forbidden to go past a walk, till they have proceeded five or six rounds, when the word is given to move at a sober trot, and to keep their ranks at a full distance from each other, regularity and deliberate movement being necessary for preventing confusion. The gentle trot is continued till it may be supposed the horses have travelled eight or nine miles, which is the extent of their first journey; they are then led off to be foddered and watered, when the trodden light straw is taken off as deep as the place where the sheaves lie close, and are but partially bruised.

As soon as this first straw is removed, one-third of the width of the bed is turned over on the other two-thirds from the inner side or circle of the bed, which narrows the circle of the next journey. The horses are again led on, and trot out their second journey, till the straw be clear of wheat. The outer part of the bed is then

turned upon the middle part, when the horses take another journey. The loose straw being then taken off, the whole remaining bed is turned up from the floor, and shaken with forks and handles of rakes, after which the horses give another tread, which finishes the work. The grain is then shoved up from the floor with heads of rakes turned downwards, and put into heaps of a conical form, in which situation it often remains exposed to the weather for several days. The correct American agriculturists, however, have houses adjoining to the treading floor, where the grain is deposited till it is cleared from the chaff and offal; though as most of them continue treading, if the weather be favourable, till the whole crop is separated from the straw, it is pretty obvious that the grain stands a considerable chance of being damaged before the several processes are concluded.

WERE we to make any comparison betwixt thrashing with a machine and treading by the feet of horses, the result would be entirely in favour of the formér. Laying aside the great damage which the grain must receive when treading, by the dung, &c. of the horses during the

process, we are almost sure that the expence of treading must be as great as that of thrashing, independent of the consideration that grain by the latter process must be more completely separated the grain from the straw, than possibly can be accomplished by the other.

SECT. VIII.

Of Fanners.

IF thrashing machines are of much advantage to the public, by separating corn completely from the straw, the introduction of fanners, or the machine by which corn is cleaned from chaff and all sorts of offal, may with justice be considered as proportionally of equal benefit to the practical agriculturist. At this day, it can hardly be conceived what difficulties the farmers of ancient times were put to before the cleaning process was accomplished ; though it may be easily ascertain-

ed, that much loss was sustained, in numerous instances, from corn remaining amongst the chaff, upon the floor of a damp barn, till a *natural* wind rose sufficient for accomplishing the necessary separation. Since the introduction of *artificial* wind, these inconveniencies and losses are completely removed, to the great accommodation of the farmer, and preservation of his property.

To one of the same family, who afterwards invented the thrashing machine, we are indebted for the introduction of fanners into this country, as can be proved by the most satisfactory written evidence. In the year 1710, James Meikle, father of the inventor of the thrashing machine, was sent to Holland, at the expence of the celebrated Andrew Fletcher, Esq; of Salton (a character well known in the annals of that period) to learn the art of making pot-barley, and constructing barley-mills; both of which arts were then utterly unknown in this country. As a preliminary to these purposes, articles of agreement were entered into betwixt Mr Henry Fletcher, brother of the gentleman above mentioned, as taking part for his said brother, and James Meikle; which articles are still extant, together

with a letter from Andrew Fletcher, Esq; to the said James Meikle, dated "Hague, 18th June 1710," giving him directions about making and purchasing several articles necessary to be used in the erection of the barley-mill. This mill, like every other barley-mill, had a pair of fanners annexed, and these fanners were the first ever employed in Scotland. From being used at the barley-mill, they were afterwards constructed upon a larger scale, and employed for winnowing corn many years before thrashing machines were introduced. The first barley-mill erected in Scotland was at Salton, in the county of Haddington; and it is not many years since the original pair of fanners, constructed and erected by James Meikle, were laid aside, being then worn out and exhausted by continual application.

It is not more than fifty years since fanners came to be *generally* used in Scotland, before that time grain being separated from the chaff by the action of wind operating between the two doors of a barn. In the windward doors a person stood dropping the grain from a sieve or riddle, and in quantities proportioned to the force of wind at the time; a process not imperfect,

when a good steady wind blowed, but not to be depended on in many instances, when the grain was wanted for seed, horse-corn, or the purpose of marketing. In short, the inconveniencies of that process of winnowing are so evident, that they do not require to be enumerated. They were, however, completely removed, in consequence of the introduction of fanners, by which the husbandman might clean his corn when he pleased. Since the thrashing machines were introduced, fanners almost in every case are annexed to them; and in some instances, where powerful machines are used, fitted internally with suitable riddles, it is perfectly practicable to measure and market the grain immediately as it comes from the machine.



SÈCT. IX.

Horse Rake.

Mr ROBERT COLLING of Barmpton, near Darlington, in the county of Durham, on having his

stubbles raked with the usual rakes drawn by men, finding they complained of the hardness of the work, contrived one to be drawn by horses, which answered the purpose very well, and was also found useful in raking hay. This rake had two wheels of two feet diameter placed in the inside of the frame ; but being of opinion that it would be an improvement to have the wheels attached to the shafts, and the frame with the rake to have no wheels, he altered it in that manner.

Mr BAILEY of Chillingham had one made in this way, (Fig. 45). The bar AB, which contains the teeth, is ninety inches long, CD forty-six inches, EF eighty-four inches, GH thirty-two inches. The teeth were at first placed at three inches distance, but were found too close where the hay was thick, as they there frequently got above the hay ; but, on taking out every other tooth this defect was remedied, and it collected the hay into rows with great dispatch and facility, but did not rake sufficiently clean. This was accomplished by going over the ground a second time with another rake, having the teeth three inches distance, and of the form Fig. 46.

CHAP. VII.

ON MANURES.

THE practical farmer, without troubling himself concerning the principles of vegetation, or inquiring about the food of plants, is perfectly satisfied, that by collecting and applying what are called manures to the land which he occupies, the fertility of the same is augmented, and greater crops, either of corn or grass, returned in the subsequent years, or so long as the strength of the manure is not exhausted; but he is equally satisfied, when the strength of the manure is exhausted, that a repetition becomes necessary, otherwise the ground would become sterile and unproductive. It is our intention to treat of manures in this plain and expressive way, and chiefly to limit our inquiries to what may be of

practical advantage. Manure is of the first importance to the farmer ; and, according to the quantity which he collects, and the judgment which guides the appropriation, his success will assuredly be regulated.

THE term *manure* is applied indiscriminately to all substances which are known from experience, either to enrich the different soils, or contribute in any other way to render them more favourable to vegetation.

THOUGH little doubt can be entertained of the utility and necessity of such substances, yet the progress hitherto made, in ascertaining the mode in which they ought to be applied, the quantity that should be made use of, and the soils for which they are respectively best adapted, has not yet reached that perfection or certainty that could be wished.

THE most superficial observation will serve to convince any intelligent person that, in an agricultural point of view, the subject of manures is of the first magnitude. To correct what is hurtful to vegetation in the different soils, and to re-

store what is lost by exhausting crops, are operations in agriculture which may be compared to the curing of diseases in the animal body, or supplying the waste occasioned by labour, or the ordinary evacuations of nature.

THE utility of manuring has, however, been questioned in some instances, particularly by *Tull* and his disciples, who assert that *tillage alone*, frequently and judiciously applied, will produce every effect that can be expected from that practice.

THAT tillage is essential to the success of agricultural operations, is a point in which all good husbandmen are agreed ; but that, by tillage alone, the earth should be made to produce a succession of valuable crops of grain or vegetables, is a doctrine which, fortunately for the advancement of agriculture, has met with very few converts. By such management poor lands would never become productive, and the richest soils would soon be exhausted.

WE need not extend our observations upon this subject farther ; for a good farmer, who

wishes to avail himself of every advantage which experience points out, will, to a certain degree, adopt, 1st, *The tillage recommended by Tull*, for the purpose of pulverising the soil, and extirpating the weeds with which it may be infested; 2d, *A regular rotation of crops*, in order that the various sorts of earth may, in their turn, according as they are calculated for different plants, become productive; and, 3d, *Endeavour to gather a sufficient quantity of manure*, not only to prevent the soil from being exhausted, but, if possible, annually to make some addition to its former sources of fertility.

BUT it is unnecessary to insist on this subject, as all agriculturalists are now agreed with regard to the utility of manures. It is of more importance to give directions respecting their collection, preparation, and application, as in these matters husbandmen, in many districts, are evidently deficient. Manure has been, and not unaptly, characterised as the magic wand of the farmer; therefore every improvement in the processes connected with its collection and appropriation, must be regarded as eminently conducive to agricultural prosperity.

SECT. I.

On the Management of Dung,

MANURE, taking the word in its broadest sense, being the first requisite of good husbandry, it shall be our business, in this section, to speak in a particular manner of the best methods of collecting, preparing, and applying that portion of it called *farm yard dung*, which, in most instances, may be considered as the chief manure used by the great body of British husbandmen. In discussing this subject, our observations shall be restricted to matters of practice, which are within the reach of every farmer, in every situation, and under every circumstance. Such practical details are better calculated to convey useful information, than abstract disquisitions concerning the food of plants, and the like. If manure is necessary for promoting the growth of plants, it is of small importance to the farmer how, and in what manner, the benefit is communicated,

Manure is beneficial, and that is sufficient. All that is farther required, is knowledge concerning the best and most approved way of increasing the quantity, and of using it in the most advantageous manner.

THE most superficial observer in rural economics must have often noticed, that a considerable number of practical agriculturists are inattentive, not only to the gathering of the raw materials, but also defective in the several steps of preparatory process, before dung can be thriftily and suitably applied. With such, very little care is used in cutting the corn crops, which, properly speaking, is the only source whence raw materials can be got. They are also too apt to dispose of any hay which may be raised upon their farms, even when prices are not so high as to tempt a breach of good husbandry. They often keep more beasts on the premises than is consistent with the quantity of provender in hand, thus reducing the stock of manure in an extraordinary degree. Besides, seldom is any care bestowed in laying up the dung, in a regular and careful way, during the winter months, and still less upon its state during the exhausting spring

winds, or the parching heat of the summer months. Instead of storing it up with regularity, and mixing the different kinds in a compact heap, it is suffered to remain as tossed from the stable and byre; continues exposed, in its rough state, to the weather; often inundated with water, and rarely touched till the cart arrives to drive it to the field.

As straw is the basis of manure, it might be expected that every good husbandman would bestow the most sedulous attention upon the cutting of his crop, so that the greatest possible quantity of the raw material may be procured. Very different, however, is the conduct of farmers in general; as, over one-half of Britain, it may be safely estimated, that at least one-fourth of the straw is left in the field, where its strength is wasted and dissipated by the rains and storms that commonly prevail at the conclusion of autumn. In some districts a stricter attention is paid to this important operation, and it is to be hoped that such an improvement will gradually extend. Independent of the additional grain which is gained, the increase of manure will

more than compensate the increased expence of reaping the crops in an accurate manner.

WHILE it is recommended, that the crop should be cut low, in order that materials for making manure may be increased, we may by no means contend for that degree of accuracy which requires that not one stalk of the stubble shall be of greater height than its neighbour; a degree of perfection accomplished, perhaps, at a greater expence than can be repaid by the benefit derived, especially when the value of labour is so enormously advanced. This kind of cutting can only be obtained, from putting a very small quantity into the hook at once, and rarely makes a perceptible increase upon the bulk; whereas, by running the sickle upon the ground, drawing a level stroke, and gathering no more into the hand than can be fairly cut, all the advantages of low shearing are obtained at a very trifling increase of expence. By a steady perseverance in this practice, from one to two tons of manure (per acre) may be annually gained, more than was procured in former times, especially where the crops are good. This annual increase must operate powerfully upon the improvement of the

country, effects being precisely similar to those of compound interest ; and, of course, furnishes the means of gradually rendering every acre of land in the kingdom fertile and productive.

THE usual modes of converting straw into dung hardly require to be mentioned. A good deal is consumed in the house by draught-horses and milch-cows ; much is applied to the littering of turnip-cattle ; and the remainder is used by lean cattle kept in the fold-yard. Though these are the general methods of consumption, it will be necessary to divide the subject into two parts, viz. The management of dung upon light lands and heavy lands ; because manure on each is prepared in different ways, used in different seasons, and applied to different crops. For light soils manure requires to be much more highly prepared than is necessary for clay soils ; and every step of the previous preparation, in order to be perfect, ought to be executed in a quite different manner.

FOR soils of the first description, where turnips are taken as a first crop, dung can hardly be too well prepared ; because the nature of the

crop to which it applied, renders a complete incorporation with the ground absolutely necessary ; without which the young plants might be starved at their very entrance into life. In the best farmed English counties which have come under our observation, dung is often kept more than a year, in order that it may be perfectly rotted ; and the late Mr Bakewell was in the habit of not applying it till reduced to a state something like black snuff. Management of this kind, however, cannot be approved of ; for, if the preparatory steps are conducted with judgment there is rarely any necessity for keeping dung over the year upon turnip farms ; besides such a delay causes a waste of the article, and serves to dissipate its strength ; at all events, a year's interest of the value of the increased produce must be lost. In general cases there is not much difficulty in preparing dung upon turnip farms ; because, in the driest season, from the nature of the food used, such a quantity of liquid passes from the animals, as to prevent burning, provincially *fire-fanging*, the greatest obstacle to the rotting of the dung that can be experienced. If turnip dung is regularly removed, if it is properly mixed with the horse litter, and other ex-

crementitious matter accumulated upon the farm, it will be found an easy task to prepare all that is made by the middle of April ; at which time the fold-yard should be cleared. What is produced after that time should be stored up separately ; receive waterings if the weather is dry ; and be reserved for clover-stubbles, or other fields that are to be dunged in autumn.

THE middle of April is mentioned as a good time for clearing the fold-yard ; but this does not prevent the work from going partially forward through the winter, when suitable opportunities occur. When driven out of the fold-yard, the dung should be laid up in a regular heap or pile, not exceeding six quarters, or four feet and a half in height ; and care should be taken not to put either horse or cart upon it, which is easily avoided, by backing the cart to the pile, and laying the dung compactly together with a grape or fork. It is also useful to face up the extremities with earth, which keeps in the moisture, and prevents the sun and wind from doing injury. Perhaps a small quantity of earth strewed upon the top might also prove useful. Dung, when managed in this manner, generally ferments very rapidly ; but, if it is discovered to be

in a backward state, a complete turn over, about the first of May, when the weather becomes warm, will quicken the process ; and the better it is shaken asunder, the sooner will the object in view be accomplished.

A SECLUDED spot of ground, not much exposed to wind, and secure from being floated with water, ought always to be chosen for the scite of such piles or heaps. If the field to which it is to be applied is at hand, a little after-trouble may be saved, by depositing it there in the first instance : But it is found most convenient to reserve a piece of ground adjacent to the homestead for this purpose. There it is always under the farmer's eye, and a greater quantity can be moved in a shorter time than when the situation is more distant. Besides, in wet weather, and this is generally the time chosen for such an operation, the roads are not only cut up, by driving to a distance, but the field on which the heap is made may be poached and injured considerably.

THE above is the most approved method of preparing dung upon turnip or light land farms ;

and a few words shall now be said respecting the management necessary upon those of a different description.

UPON clay soils, where wheat forms a principal part of the crop ; where great quantities of beans are cultivated, and few turnips sown, unless for the use of milch cows, the rotting of dung is not only a troublesome but an expensive affair. Independent of what is consumed by the ordinary farm-stock, the overplus of the straw must somehow or other be rotted, by lean cattle kept in the fold-yard, who either receive the straw in racks, or have it thrown across the yard, to be eaten and trodden down by them. According to this mode of consumption, it is evident that a still greater necessity arises for a frequent removal of this unmade dung, otherwise, from the trampling of beasts, and the usual want of moisture, it would compress so much as altogether to prevent putrefaction. To prepare dung sufficiently upon farms of this description, is at all times an arduous task, but scarcely practicable in dry seasons ; for if it once gets burnt (*fire-fanged*), it is almost physically impossible to bring it into a suitable state of preparation af-

terwards ; and, at all events, its virtues are thereby considerably diminished. The year 1803 furnished strong proofs in support of what is here maintained ; for, owing to the goodness of the weather during the winter and spring months, less dung was driven out than usual ; and the consequence was, that on few clay farms was the dung half rotted, even where the most anxious efforts were bestowed upon watering and turning it when the season advanced. The continued dryness of the weather was no doubt an exception to that of common seasons, and increased the difficulties which, at all times, are undergone in such situations ; but, had it been equally wet as it was dry, the propriety of frequent removals would not have been less urgent. Straw flung out in considerable portions to the fold-yard, after being compressed by the trampling of cattle, becomes rather like a well packed stack than a mass of dung in a preparatory state. The small quantity of urine and dung made by the animals is barely sufficient to cause a slight fermentation ; and this slight fermentation, when the heat gets into a compressed state, is sure to bring on fire-fanging, as already said ; after which its original powers can rarely be restored. To prevent such an in-

jury, no measure can be so successfully used, as a frequent removal of this unmade dung, especially if the weather is wet at the time. If people can stand out to work, there cannot be too much wetness when executing this operation for there is always such a quantity of the straw that has not passed through the entrails of the cattle, as renders it almost impossible to do injury, in the first instance, by an excess of moisture.

It is therefore recommended, upon clay-land farms, especially those of considerable size, that the fold-yard be frequently cleared; and that the greatest care be taken to mix the stable or horse dung in a regular way with what is gathered in the fold-yard, or made by other animals, in order that a gradual heat or fermentation may be speedily produced. Where the materials are of the sorts now described that is, a small quantity of dung, or excrementitious matter, and a large store of unrotten straw, only partially moistened), no damage can ensue from putting horses and carts upon the heap; nay, a positive benefit will be gained from this slight compression. At the same time, we are aware, that

the sentiments of many able and judicious farmers are different on this point; it being their opinion, that the natural pressure of the materials is quite sufficient, and that any additional pressure is accompanied with injurious consequences. We are, however, satisfied, that such ideas are unfounded; having tried both methods upon an extensive scale, and, from the results, feel ourselves justified in recommending the above mode of management. Perhaps this difference of sentiment may arise from not attending to the very different qualities of dung on different farms; for the propriety of abstaining from putting horses and carts upon such heaps or piles, containing materials which can be called dung, even though it may be in an unripe state, is already allowed. It is contended, however, that no injury is sustained from slightly compressing a mass of rough materials; nay, that such is attended with beneficial effects; for, if the materials were laid up with a fork, or a grape, as recommended in the case of turnip or half rotten dung, the small portion of moisture therein contained would speedily be wasted or evaporated; a circumstance which often occurs, especially when dry weather sets in soon after the heap is made up. Besides, driv-

ing a one-horse cart over a surface of materials only one stage removed from the condition of dry straw, will never prevent fermentation. If left in the fold-yard, the constant treading of the cattle therein confined, and the daily increased weight of the heap, may undoubtedly produce that evil; but this is effectually prevented by frequent removals, especially if rainy weather prevails at the time. Few objects deserve to be more sedulously attended to by every farmer who studies his own interest.

THE heap or pile, as already recommended, in the case of turnip dung, should be formed in a secluded spot, if such can be got at hand; because the less it is exposed to the influence of the sun and wind, so much faster will fermentation proceed. The heap should be constructed on a broad basis, and several separate ones are necessary, so that too much may not be deposited at a time, which, to a certain extent, would bring on the very evil we have all along been endeavouring to avert. By shifting the scene frequently, and allowing each covering or coat to settle and ferment, before laying on any more, the most happy effects will follow, and these

heaps (at least all such as are completed before the first of May) may reasonably be expected to be in a fit condition for applying to the summer fallow fields, in the end of July, or first of August. If the external parts get dry at any time during the process, it will be proper to water them thoroughly, and in many cases to turn over the heap completely. It may be added, that much benefit has been experienced from laying a thick coating of snow upon such heaps, as, by the gradual melting thereof, the whole moisture is absorbed, and a strong fermentation immediately follows.

THE same method of management may be continued during the summer months, so far as circumstances permit, though it rarely happens that dung collected at this advanced period is fit for use in the same season, unless it be such as is made by keeping horses and cattle in the house upon green food. Perhaps, as a general principle, it is proper to thrash out all grain before summer arrives (a small quantity for litter and other necessary purposes excepted) in order that the full value of the raw materials, when converted into manure, may be gained. Straw thrash-

ed in the summer months always wants a good deal of its original strength; it is broken and hashed by the mills; therefore a large portion must at once be thrown to the fold-yard, where its strength is still more exhausted and dissipated. Even when stacked carefully, it will be found next winter to produce much less bulk of dung, than if it had been used at the proper time; and interest of the amount for one year is lost;—all which things, added together, will be found equal to one half of the original worth.

UPON large farms, where the management of manure is sufficiently understood and practised, it is an important matter to have dunghills of all ages, and ready for use whenever the situation of a field calls for a restorative. No method of application to clay soils, however, is so beneficial as during the year of summer fallow, though, in such situations, a greater stock of manure is often gathered than is required for the fields under this process.

AFTER all, it must be acknowledged, that, under every exertion, it seldom happens that dung on clay farms, where turnips are not grown,

can be so well prepared as upon those employed in the culture of that beneficial root. This has induced many farmers to cross nature, and attempt the cultivation of turnips upon soils physically unfit for producing them with advantage; and perhaps much money has been lost in carrying such schemes into execution. Perhaps a clay-land farmer had better submit to all the disadvantages accompanying the preparation of manure in his particular situation, than try to get free of them by the culture of turnips. It is a consolatory circumstance, however, that clay soils have a good digestion; they are not so nice in their food as gravels and sands, requiring only a good belly-full, and frequent meals. It likewise deserves attention, that dung applied to a clay fallow, at the end of summer, has full time to incorporate with the ground before the crop, sown thereupon, stands much in want of its invigorating support; consequently, though of apparent inferior quality at the time of application, may, in reality, be possessed of equal powers for fructifying the ground, as if it had reached a higher state of preparation.

WE may now notice some instances of slovenly management in our sister kingdom, respecting the management of manure, particularly in the midland counties, where grass husbandry is extensively practised. In these districts, it is very common to use a considerable proportion of their hay in the fields, during the winter months, instead of consuming it in the house or fold-yard, where the manure produced could readily be collected, and properly managed. Sloth and waste are the parents of this custom; a custom which ought to be interdicted by every proprietor who is disposed to regard either his own interest or that of the country, much of the article being absolutely rendered useless by the feet of the beasts so maintained, while the ground is most unequally and partially dunged; that is to say, the richest and driest parts are sure to receive the greatest store.

SOME thoughts relative to the application of dung, a subject of as much importance as the collecting and preparing of it, shall now be offered. According to the plan suggested, the subject may be considered in two points of view, viz.

as connected with light and clay soils : or, more particularly, as relative to soils on which turnips constitute the first or leading crop ; and those where naked summer fallow is the preparatory step of the subsequent rotation.

SOME previous remarks, connected with the right management of dung in all soils, and in every situation, are however necessary, so as repetition may be afterwards avoided : these are, that no greater quantity ought to be given at one time than is sufficient to fertilize the ground ; in other words, to render it capable of producing good crops, before the time arrives when a fresh doze can be administered. In a rotation of *four*, one dunging is supposed to be necessary, it being understood that two culmiferous crops are only taken ; but in rotations of *sixes* and *eights*, the common ones followed by good farmers on heavy or wet soils, two dungings are necessary ; otherwise the crops raised will prove proportionally defective, before the expiration of the courses. It is evident that, under the common resources of arable land, such repetitions are impracticable, unless the utmost frugality is studied in the dis-

tribution ; but, where this is neglected, a regular system can seldom be adhered to. The errors of former times consisted in giving too great a quantity at once, thereby depriving the ground of its regular nourishment ; in other words, the soil rioted in the midst of plenty for two or three years, and fasted and starved for several succeeding seasons. Hence the generality of fields were either too rich or too poor ; either saturated with manure, or completely barren from the want of it ; whereas, had supplies been furnished in an economical manner ; had the quantity of manure on hand been distributed with judgment, a more uniform produce would have been the consequence. The new system of applying manure corrects all these errors, in so far as local circumstances will permit. Accordingly, a small quantity is now bestowed at once, and the dose frequently repeated. The ground is regularly fed ; but never surfeited with a profusion of victuals. Hence the crops constituting a regular rotation are more uniformly good, and a greater proportion of the valuable grains are raised, than could be accomplished in former times.

THOUGH land can rarely be rendered too rich for carrying green crops, yet it is well known that the same observation will not hold good when applied to wheat, barley, and oats; but that such may be, and often have been, materially injured in consequence of heavy manuring. Look at the scite of a dunghill, and it will rarely be found that a crop of good grain is produced upon it. There is a great flush of straw, often of bad quality, and a small quantity of inferior grain, little better than if the labours of nature had ended in an abortion. The like consequences, though certainly in a less degree, generally took place with the first crops of former times, after summer fallow and dung, especially if the weather proved wet when the grain was filling; and to avoid such evils, many farmers, at this day, in the neighbourhood of great towns, decline laying manure upon their fallows, knowing that the vegetable food contained in these lands, if reinforced with an additional supply, would, in nine cases out of ten, prove destructive to the ensuing wheat crop. It is also often observed that, where a heavy coat of dung has been given to a well-wrought fallow, such a degree of fermentation takes place in the succeeding spring, as alto-

gether to free the roots of young wheat from their natural hold ; thus occasioning them to starve for want of nourishment, though surrounded with abundance of food.

BUT, passing over these evils, and even upon the supposition that they never existed, still the practice of administering manure in an economical manner may be supported by arguments of a different nature. If a quantity is bestowed sufficient to impregnate the ground, all above that quantity deserves to be considered as profusely thrown away ; at least the benefit of it is in a great measure sacrificed. Manure, upon many soils, is soon deprived of its enriching powers ; upon all, its strength is dissipated and carried off by heat, wind, and rain ; therefore, the oftener it is repeated, the greater will be the benefit derived from the application. Let us not be mistaken here. We are not arguing on the supposition, that the farmer has it in his power to dung land at his pleasure, as may be the case in the vicinity of great towns. Our arguments merely relate to the situation of the ordinary farmer, who must

act upon his own supplies ; who possesses but a limited portion of manure, and whose care should be directed to manage that portion in such a way as to derive from it the greatest possible advantage. To make our meaning clear :—If one hundred carts of dung, each containing one ton or thereby, are laid upon four acres of land, and the same quantity, and of similar quality, is laid upon eight acres, we maintain that a very considerable advantage will be derived in the latter way more than in the former ; independent of the stress that might be laid upon the circumstance of keeping a great part of every farm in a penurious, consequently in an unproductive state, when a profuse system is adopted.

ANOTHER general remark occurs ; that is, concerning the utility of spreading dung with accuracy ; in other words, dividing it into the minutest particles, thereby giving every part of the ground an equal supply of food. This practice was miserably neglected in former times, and is still less attended to than its importance deserves. In fact, few operations call more loudly for the attention of the farmer ; and none in which a more general improvement has taken place. The

superficial and slovenly way in which dung was formerly spread must be fresh in the memories of most people. In many instances the big heap was only broken down, as it were, into a number of small ones ; and, as for tearing or shaking the dung asunder, such an idea then rarely entered into the head of any man : though it is obvious that, without making a complete separation, the article could neither be sufficiently covered in, nor its virtues be conveyed to the soil. Perhaps the increased attention now bestowed in all the cultivated districts to the spreading of dung, originated from the measure of limiting the quantity applied. When forty, fifty, nay even sixty double loads, were applied to an acre, it was not very difficult to cover its surface, even with an imperfect separation, though it certainly was impracticable to bury the big lumps with a furrow of ordinary size ; but when the quantity was brought down to eighteen and twenty loads, and more so, when twelve or fourteen loads were thought sufficient, a different conduct became absolutely necessary. Another improvement also followed, viz. spreading dung when raw or green, that is, immediately after the carts ; in which way, at least during summer, it will be

separated at one-half of the expence, and to much better purpose, than when it is suffered to lie in the heap for a day or two. In short, it is a sure mark of a slovenly farmer, to see dung remain unspread upon the field, unless it be in the winter months, when it may happen that hands cannot be got for carrying on such operations with the usual regularity. At that time the injury sustained by losing a few days is not great, though, as a general rule, it will be found that the expence is always smallest when the carts are regularly followed up.

HAVING made these remarks, we proceed to say a few words on the application of dung.

WHEN turnip husbandry forms the chief branch of fallow process, dung is naturally of a superior quality, and requires little artificial management for bringing it to a proper state of preparation. In the greatest part of Scotland, and even in England, where the drill and horsehoeing system is practised, the common, and undoubtedly the most approved way of applying dung to turnips, is by laying it in the intervals of the drills or small ridges, which are previously

made up by a *bout*, or two furrows of the plough. These drills or ridges are formed at a distance of from twenty-four to thirty inches from the centre of each ; and by driving the horses and cart along the middle one of the spaces intended to be manured, the dung is drawn out, either by the cart-er, or by another man especially appointed for that purpose, in such proportions as the poverty of the soil, or the disposition of the occupier, may reckon necessary. If the breadth of three drills are only taken at a time, the dung stands a better chance of being regularly administered ; for it often happens that, when a greater number are included in one space, the two outside drills receive a less quantity than the intervening ones. Those, therefore, who limit themselves to three drills, generally divide the spreaders ; as it requires six hands, women or boys, to follow up what is usually called *a head of carts*, the number of carts to a head being regulated by the distance of the dunghill, or the kind of road over which it is to be carried. Others again, thinking that, by manuring only three drills at a time, the travel of the horses is greatly increased, and time wasted when it is particularly precious, take five drills into one space, and, by putting the strong-

est hands to the two outside drills, making these go in front, thereby getting the first of each heap, and placing an able confidential servant to assist and superintend the whole, consider that the work is equally well performed, while a greater quantity is put through their hands in a given time. Both plans have their votaries, though the difference between them is not of much consequence. The main objects are, to provide a proper bed for the dung, which is easily done by holding a deep furrow when the drills are first made up; and to shake it well asunder, or divide it into the smallest parts, so that an instant and complete separation may take place. To accomplish this in the most perfect manner, hand-work in some places is resorted to; but the common custom is to do it with small light grapes, or forks; and it is wonderful how adroitly the spreading is performed by small boys and girls, after they are a little time accustomed to the task.

THE quantity of dung usually given for turnips is from twelve to fifteen double cart loads, of one and a half cubic yards to a Scots acre. In some cases only ten loads are given; but the land ought to be in high condition where such a small

quantity is bestowed. In fact, no soil can be made too rich for turnips or other green crops, peas excepted ; but the object to be attended to in this, and every other case, is an allotment of the manure collected upon the premises, in such a way as that the greatest possible return over the whole farm, not from a particular field, may be gained by the occupier.

As to the mode of applying dung to potatoes, a few particulars may be stated. The culture of this esculent is in several respects similar to that of turnips, but in others it differs materially. Potatoes are planted earlier in the season than turnips ; the ground rarely receives so much work ; the soils upon which they are cultivated are more variable ; and the dung considered to be most suitable for promoting their growth, does not require such high preparation. Many farmers, notwithstanding these circumstances, follow out the same process as described under the head of turnips. After the ground receives three, or at most four ploughings, the drills are made up, dung deposited in the intervals, the seed planted above the dung, and the drills re-

versed ; after which, say at the distance of two or three weeks, a slight harrowing is given. Several objections occur to this mode ; such as, that the seed is generally kept too near the surface, which, in dry seasons, proves unfavourable to the crop ; the dung, unless it be very short, is apt to be drawn up by the harrows, and the seed removed from its original bed. These things induce other farmers (and probably they are right) to adopt a different system : They avoid making up drills, but dung the ground in what may be called the broad-cast way ; and, entering the plough, plant the seed in every third furrow, into which only the dung is raked ; and so on till the whole is finished. Before the young plants appear, or even after they are above the surface, a complete harrowing is given, which is considered as equal to a hand-hoeing ; and from the dung being completely covered, scarce any of it is dragged up, while the seed, being undermost, none of it is disturbed by the operation. Both modes have their advantages and disadvantages. The first is carried on with less trouble, and more regularity ; the last, perhaps with most advantage to the crop, especially on heavy soils—the seed furrow loosening the ground more effec-

tually than can be done by the forming of drills. Several farmers do not dung their potatoe fields ; but, reserving the manure till the crop is removed, find the remainder of the rotation greatly benefited. Potatoes scourge severely, and, in general cases, require a larger quantity of dung than turnips ; but as the extent of land under this culture is not great in common farming, few people grudge this extra quantity, because, except in a few favoured situations, a good crop cannot otherwise be reasonably expected.

WE come now to the second branch of the subject, the manuring of clay soils, or those where turnips are not taken as a first crop. Such, it is presumed, include at least three-fourths of Great Britain, though recent circumstances may have lessened their extent considerably.

UPON all soils incumbent on a wet or close bottom, whether characterised as clay, loam, or moor, it may be laid down as a primary principle, that dung cannot be so profitably applied, as while the ground is under the process of summer fallow. Theorists, and half-bred agriculturists, may reason as they please against a continuation

of this ancient practice; they may assert, with the utmost confidence, that immense benefit would be gained by laying it aside, and resorting to the drill system; but their arguments will have little effect upon people practically acquainted with the management of argillaceous soils, who do not take one season as a rule, but are guided by the dictates of common sense acquired, during successive years, in the school of experience. Whatever dispute may have happened on this subject among theorists, the opposite side of the question is rarely espoused by actual farmers, who have farmed wet lands, even by those whose practice in some degree sanctioned a contrary opinion, having been influenced to make temporary deviations from motives of expedience, and not from general principles. It is sometimes necessary for such to raise a few turnips, in order that live-stock may be enabled to meet a market, or be preserved at a critical period; others have partially resorted to this culture, as the means of rotting dung; but, under whatever impressions they acted, few or none ever judged that such deviations could be defended upon abstract principles, though certainly they might be supported by expediency and existing circumstances. In-

clined to believe that such are the ruling sentiments of British agriculturists, we shall enter upon the important question, How, and in what manner, can dung be most profitably applied to clay lands, or those, of whatever variety they may be composed, that are incumbent upon a close bottom or sub-soil?

IT has already been noticed, that the best and most appropriate time for applying manure to clay soils, is when the ground is under the process of summer fallow. When under this process, the soil, comparatively speaking, is reduced into minute particles, which affords an opportunity of conveying the virtues of manure through the veins or pores of all its parts. The soil, at that time, is also freed from its aboriginal inhabitants; quickens and other root-weeds, who claim a preferable right of support; hence the artificial plants, afterwards cultivated, possess, without a rival, such supplies as have been granted, without any deduction whatever. In short, without laying any stress upon elementary effects during the process, it does not admit of a doubt, that the same quantity of manure, bestowed upon the ground when summer fallowed, will pro-

duce a greater return to the occupier, than if it had been applied at any other stage of the rotation.

UNDER these impressions, it appears that dung should not be laid upon fallows before they are completely cleaned; though, no doubt, in wet summers that operation is not easily accomplished. To make sure work, the fallows, if possible, should be early stirred, and no opportunity slipped of putting them forward with the utmost expedition; for it rarely happens, at least in Scotland, that much good can be done towards the destruction of root-weeds after the month of July. Before that time, a judicious farmer will have his fallow dressed up, and in a suitable state for receiving dung. It should be well harrowed, if the weather is favourable, previous to the dung being laid on; and if rolled, or made smooth, the spreaders will be enabled to perform their task with much more precision.

AT the proper season, every other operation ought to be laid aside, so that dung may be expeditiously drove out. To do it in wet weather is attended with pernicious effects; the horses are oppressed, a longer time is required, the land

is poached, and in some measure deprived of all benefit from the previous fallow. These circumstances will be reflected upon by the attentive farmer; they will stimulate him not to lose a moment when the weather is favourable, and prevent him from forcing on the work, when injury rather than benefit may be expected. After all, seasons are sometimes so perverse, as to render every rule nugatory. These must, however, be taken as they come; avoiding at such times to break the land down, acclivating the ridges sufficiently, and keeping the water-furrows completely clear. By attending to these matters, opportunity may be laid hold of, by the active farmer, several days sooner than by his slovenly neighbour; or at least the work will be executed in a much more perfect way than if they had been neglected.

THE quantity of dung usually applied to fallows in ordinary condition is from fourteen to twenty double loads per Scottish acre; though often good crops are reaped when twelve loads only have been given. So much, however, depends upon the condition of the land, upon the quality of the dung, and the way in which the

carts are loaded, that no precise meaning can be communicated by such expressions. A decent load may contain one cubic yard and three-fourths, and weigh a ton, or thereby. It also deserves notice, that less dung will serve some lands than others, especially if they have lately been ploughed from grass; but, at all events, sixteen such loads as are mentioned will answer for any sort of soil, unless it has been previously quite wrought out. Even if it were in this forlorn state, it is better management to dung upon the stubble of the first crop, than to give an overdose when under summer fallow.

All dung laid upon summer fallow ought to be spread the moment it is pulled out of the cart. It can at no other time be done so well, or so cheap; though, on many farms, small ones especially, where a full supply of hands are wanting, this beneficial practice is much neglected. Four spreaders, boys or girls, with an attentive overseer to follow up, and supply any omissions, are sufficient for one head of carts; the number included in a head being regulated by the distance of the field from the dunghill. Some farmers employ a person, on whom they can de-

pend, to draw the dung from the cart, who has judgment to proportion it according to circumstances, and is responsible for any failure in the execution ; but the carter is the person usually employed, though, unless a boy is given him to drive, a regular distribution can hardly be expected. To insure accuracy in laying down dung, fields are sometimes thrown into a chequered figure ; and, a heap being drawn out into each square, the quantity required for the whole may be easily ascertained. The great object, after a regular and economical distribution, is to shake and part the whole completely ; as, by minute attention to this circumstance, a much greater effect is necessarily produced.

AFTER the fallows are dunged, the remainder in hand is reserved for what may be called intermediate dunging, generally either upon clover stubbles, upon wheat stubbles previous to taking beans, or upon bean stubbles before the seed furrow is given for wheat. It is obvious, that the farmer must be regulated, in this intermediate dunging, by the weather at the time, though it rarely happens but that dung may be got out upon clover stubbles at one time of the winter or

other. When applied to beans, a beneficial practice, the dung, as we said above, is by some people laid upon the wheat stubble, and ploughed down before winter ; hence it is in full action in the spring, when the seed furrow is given. Others make up drills at seed time, depositing the dung in the intervals, as for turnips or potatoes ; but it seldom occurs that weather can then be got, at least on real bean soils, for executing this management.

It remains only to be stated, that many arable farms, under the strictest economy, are unable to furnish supplies for an intermediate dunging, at least to its full extent ; but persons so circumstanced have it always in their power to overcome this defect, and preserve a regular rotation, by keeping certain fields longer in grass ; which of course will yield weightier crops when broken up, and stand less in need of manure during the after rotation. As, for instance, in a rotation of six, and it is here that the greatest short-coming is felt, grass seeds to a certain extent, say a half, may be thrown in with the crop of wheat taken after fallow, which is the second year of the rotation ; this part may be pastured for three years,

and broken up in the sixth for oats, which concludes the course. Again, in a rotation of eight, grass seeds, in like manner, may be sown with a part of the fallow wheat, which part can be pastured for three years, then broken up for oats, succeeded by beans and wheat. By such arrangements, made according to circumstances, it is an easy matter to preserve a regular rotation, and to proportion the corn crops to the quantity of manure collected upon the premises.

WE may add, that the practice of soiling or feeding horses and cattle in the house or farm-yard, is eminently calculated to increase the quantity of manure upon every farm, and to improve its quality.

THE soiling of horses, in the summer months, on green clover and rye-grass, is a practice which prevails in every corn district where farm labour is regularly executed. The utility of the practice does not need the support of argument; for it is not only economical to the farmer, but saves much fatigue to the poor animal: besides, the quantity of dung thereby gathered is considerable.

REFLECTING upon the advantages of this practice, it has often occurred to us, that cattle, *i. e.* oxen and cows of all sorts, might be supported and fed in like manner during the whole of the grass season. It is well known that milch-cows have, in several instances, been so kept, but it has rarely happened, that other descriptions of cattle have been fed for the butcher according to this mode, though it is perfectly practicable. No doubt a considerable degree of trouble necessarily attends the measure, but this is an objection that may be urged against every scheme for improvement. It was urged against summer-fallow at its introduction, and is still urged in several districts against the drilling of turnips. If the advantages, however, which would attend a general soiling, exceed the trouble which it occasions, we apprehend the measure is not to be combated on this ground.

LET any person, for a moment, view a field of grass depastured with cattle, especially if the weather is wet, and he will soon be convinced of the great loss sustained from the feet of the animals and of the waste which is made in consequence of their roaming at large. Perhaps it may be

estimated, that in general cases, near one half of the grass is, by this means, rendered useless; at least we are certain, from feeding milch cows in the house, that one half of the extent of land will suffice for house-feeding, that is required when depasturing is practised. Probably another advantage would follow. The land, from being covered with grass, would not only produce an increased quantity, but also be greatly benefited by the exclusion of air before the grass was cut or removed. When depastured, it is obvious, that none of these things can happen. If the grass was eaten any thing bare in the beginning of the season, its future growth must be stopped by the drought which usually prevails in the early part of summer; and when the ground is not fully covered with plants, the benefit of the grazing system, towards the improvement of land, is only partially experienced.

BUT the chief benefit of soiling may be considered as arising from the immense quantity of fine dung thereby produced, which can be returned to the ground in the succeeding seasons, after being properly fermented and prepared. In

all corn farms, at least those of clay soils, it is a work of great difficulty to rot straw; and much of it is misapplied, in consequence of imperfect preparation. A sense of these things has induced many farmers to attempt turnips in situations not qualified for raising them with profit; but even these attempts, though in some respect useful, by converting a part of the straw into dung, do not fully answer the intended purpose. The superfluity which remains after the turnip season is over (and this upon corn farms often exceeds a third of the crop), is seldom used in a beneficial way. If stacked in the yard, it is bleached and dried by the sun and wind; and when used in the next season, is found to be unfit for the support of animals, being divested of the powers which it originally possessed. Were cattle therefore soiled either in the house, or in separate divisions of the fold-yard, all the straw thrashed in the summer months might be immediately converted into dung, the quality of which would be equal, if not superior, to what is made from turnip feeding.

To carry on this mode of feeding in a regular way, it would be necessary to have a consider-

able quantity of tares sown at different times, so as the interval betwixt the first and second crops of clover might be filled up. Perhaps early sown turnips might prove an useful assistant. A stack of hay would also be necessary, in the event of bad weather setting in, or circumstances occurring to prevent a regular supply of green food.

FROM considering the time taken to cut and bring home grass for farm horses, we are led to think, that one man and a boy, with a single horse cart, would be able to supply thirty head of ordinary sized cattle with cut grass, if the crop was middling good, say one that would yield two hundred stones of hay per acre, and the distance of the field from the home-stead not exceeding half a mile. If the beasts were tied to a stake, it would require an additional hand to litter and clean them; but in small fold-yards, well supplied with water, and provided with a shade to which the animals might retire in a hot sunny day, this mode of feeding would be most eligibly executed. Perhaps the number put into each yard should not exceed six or eight, and these should be equally matched if practicable.

IN this way, the farmer of clay soils may be equally benefited by grass crops, as those of a light and gravelly nature are by turnips. The only difference would be, that they would feed at different seasons, or at the time best suited to the circumstances in which they were placed. Dung, as has been already said, is the mother of good crops; and it appears that no plan can be devised by which a large quantity can be so easily and cheaply gathered, or by which straw can be so effectually rotted, and rendered beneficial to the occupier of a clay land farm, as the soiling of cattle in the summer season. In a word, the dung of animals fed upon green clover, may justly be reckoned the richest of all dung. It may, from the circumstances of the season, be rapidly prepared, and applied to the ground at an earlier period than any other sort of dung. The subject will again be noticed, when the management of grass land is under consideration, when the advantages arising from it will be more particularly described.

SECT. II.

Of Compost Middens.

THE use of manure in the shape of compost, or ingredients of various qualities, mixed together in certain proportions, has long been a favourite practice with many farmers; though it is only in particular situations that the practice can be extensively or profitably executed. The ingredients used in these composts are chiefly earth and lime; sometimes dung, where the earth is poor; but lime may be regarded as the main agent of the process, acting as a stimulus for bringing the powers of the heap into action. Lime, in this view, may be considered as a kind of yeast, operating upon a heap of earth as yeast does upon flour or meal. It is obvious, therefore, that unless a sufficient quantity is given, the heap may remain unfermented; in which case little benefit will be derived from it as a manure.

THE best kind of earth for compost is that of the alluvial sort, which is always of a rich greasy substance, often mixed with marl, and in every respect well calculated to enrich and invigorate barren soils, especially if they are of a light and open texture. Old yards, deep head-lands, and scourings of ditches, offer themselves also as the basis of compost middens; but it is proper to summer-fallow them before hand, so that they may be entirely free of weeds. When the lime is mixed with the soil of these middens, repeated turnings are necessary, that the whole may be suitably fermented; and some care is required to apply the fermented mass at a proper time to the field on which it is to be used.

THE formation and conveyance of compost being expensive, it becomes an important object to save labour in the previous steps of preparation, and in the concluding one of applying it to the soil. The first part of the object is gained by using horse instead of manual labour, when the lime is incorporated with the earth, and when the after turnings are bestowed; and the other is lessened considerably when the compost is

laid on a field adjoining the one where it is prepared.

A FEW words may be necessary with respect to the quantity of lime required to produce a suitable fermentation, though here we can at best but speak at random, because the proper quantity falls to be regulated by the nature of the earth which is meant to be used at the basis of the future compost. As the quantity of the compost to be afterwards applied to the soil must, however, be ascertained by its quality, and as sixty cubic yards of alluvial compost may be viewed as containing the same portion of nutritive substance as one hundred yards of headlands and ditch scourings, we shall assume eighty yards as a medium dose for a Scotch acre of ground, and from this datum endeavour to fix the quantity of lime that is required. From trials that we have frequently made, it appears, that two bushels of lime shells, Winchester measure, will sufficiently ferment a cubic yard of earth of a medium quality; therefore, that forty bolls of lime-shells, wheat measure, or twenty-six and two-thirds barley measure, are required to ferment compost for an acre of ground, where the basis consists

of ordinary materials. This goes upon the supposition that an admixture is regularly conducted, and that eighty cubic yards of the compost is sufficient to impregnate or enrich the field on which it is to be applied.

The benefit of such a compost in nourishing soils is even greater than what is gained by dressing them with dung; though it is to be regretted, that it rarely happens, where such soils are predominant, that materials such as we have recommended can be procured in any quantity. Another sort of compost, of which moss is the basis, has therefore been recently tried, and with tolerable success. Should a repetition prove equally successful, and the first trials be confirmed by the experience of others, agriculture will be benefited in a quarter where hitherto small improvement could be introduced.

ON this subject, Lord Meadowbank, one of our supreme judges, has lately favoured the public with a small pamphlet, containing directions for making compost mounds of peat-moss. We therefore use the freedom of borrowing his lord-

ship's directions, trusting that the public good may thereby be in some measure promoted.

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

TAKE the peat-moss to a dry spot, convenient for constructing a dunghill to serve the field to be manured. Lay the cart-loads of it in two rows, and of the dung, in a row betwixt them. The dung thus lies nearly on the area of the future compost dunghill, and the rows of peat should be near enough each other, that workmen, in making up the compost, may be able to throw them together by the spade. In making up, let the workmen begin at one end; and at the extremity of the row of dung (which should

not extend quite so far at that end as the rows of peats on each side of it do), let them lay a bottom of peat, six inches deep and fifteen feet wide, if the grounds admit of it ; then throw forward, and lay on, about ten inches of dung above the bottom of peat ; then add from the side-rows about six inches of peat ; then four or five of dung, and then six more of peat ; then another thin layer of dung ; and then cover it over with peat at the end where it was begun, at the two sides and above. The compost should not be raised above four feet, or four feet and a half high ; otherwise, it is apt to press too heavily on the under parts, and check the fermentation. When a beginning is thus made, the workmen will proceed working backwards, and adding to the column of compost, as they are furnished with the three rows of materials directed to be laid down for them. They must take care not to tread on the compost, or render it too compact ; and, of consequence, in proportion as the peat is wet, it should be made up in lumps, and not much broken.

IN mild weather, seven cart-loads of common farm-dung, tolerably fresh made, is sufficient for

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

THE dung to be used should either have been recently made, or kept fresh by compression ; as, by the treading of cattle or swine, or by carts passing over it. And, if there is little or no litter in it, a smaller quantity will serve, provided any spongy vegetable matter is added at making up the compost, as fresh weeds, the rubbish of a stack-yard, potatoe-shaws, sawings of timber, &c. And as some sorts of dung, even when fresh, are much more advanced in decomposition than others, it is material to attend to this ; for a much less proportion of such dung as is less advanced will serve for the compost, provided care is taken to keep the mass sufficiently open, either by a mixture of the above-mentioned substances,

or, if these are wanting, by adding the peat piecemeal; that is, first making it up in the usual proportion of three to one of dung; and then, after a time, adding an equal quantity, more or less, of moss. The dung of this character, of greatest quantity, is shamle dung, with which, under the above precautions, six times the quantity of peat, or more, may be prepared. The same holds as to pigeon-dung, and other fowl dung; and, to a certain extent also, as to that which is collected from towns, and made by animals that feed on grains, refuse of distilleries, &c.

THE compost, after it is made up, gets into a general heat, sooner or latter, according to the weather, and the condition of the dung: In summer, in ten days or sooner; in winter, not perhaps for many weeks, if the cold is severe. It always, however, has been found to come on at last; and, in summer, it sometimes rises so high as to be mischievous, by consuming the materials (fire-fanging). In that season, a stick should be kept in it in different parts, to pull out and feel now and then; for, if it approaches to blood-heat, it should either be watered, or turned

over ; and, on such an occasion, advantage may be taken to mix it with a little fresh moss. The heat subsides, after a time, and with great variety, according to the weather, the dung, and the perfection of making up of the compost ; which then should be allowed to remain untouched, till within three weeks of using, when it should be turned over upside down, and outside in, and all lumps broken : then it comes into a second heat, but soon cools, and should be taken out for use. In this state, the whole, except bits of the old decayed wood, appears a black free mass, and spreads like garden mould. Use it, weight for weight, as farm-yard dung ; and it will be found, in a course of cropping, fully to stand the comparison.

LET it be observed, that the object in making up the compost is to form as large a hot-bed as the quantity of dung employed admits of, and then to surround it on all sides, so as to have the whole benefit of the heat and effluvia. Peat, nearly as dry as garden-mould in seed-time, may be mixed with the dung, so as to double the volume and more of it. Workmen must begin with using layers ; but, when accustomed to the

just proportions, if they are furnished with peat moderately dry, and dung not lost in the litter, they throw it up together as a mixed mass ; and they improve in the art, so as to make a less proportion of dung serve for the preparation.

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

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

LIME has been previously mixed with the peat ; but the compost prepared with the mixture, or with the simple peat, seemed to produce

equally good crops. All the land, however, that it has been tried on, has been limed more or less within these twenty-five years.

THE rich coarse earth, which is frequently found on the surface of peat, is too heavy to be admitted into this compost; but it makes an excellent top-dressing, if previously mixed and turned over with lime.

PEAT, prepared with lime alone, has not been found to answer as a good manure. In one instance, viz. on a bit of fallow sown with wheat, it was manifestly pernicious.

SECT. III.

Of Lime.

LIME is regarded by some people as a manure, by others as a stimulus, which can only be profitably applied where the soil possesses some dormant

principle of fertility that must be roused into action. In fact, the *modus operandi* of lime is imperfectly understood, though the greater part of agriculturists are pretty well acquainted with its effects. It is sufficiently understood, that land which has been long in grass contains much vegetable matter, and that the trouble and expence of liming it will be amply repaid to the cultivator; but the propriety of applying lime on old arable lands has been questioned, and with much justice, by the most part of practical agriculturists, and their doubts on that head are confirmed by the fullest experience. Were lime a manure, it would be a noble substance for enriching, and restoring fertility to, lands worn out by a succession of corn crops; but as worn-out land is not restored to fertility by the application of lime, we are warranted to consider it in a different light, or, in other words, as an article calculated to bring certain principles into action, previously possessed by the soil. This conclusion is sanctioned by experience; and experience is a far better guide than the most plausible theory.

THOUGH lime has been used with very great success in every part of Great Britain, it is evident that the grossest errors have been committed in the management of land to which it was applied ; and, what is worse, that the extent of these errors was in direct proportion to the effect produced upon the soil by the application. This remark applies more to the former state of husbandry than to the present practice, because the former rule was to crop the ground so long as it would make a good return, without considering that ground, treated in that manner, would soon be wasted and exhausted. Indeed, when lime duly operates, the whole powers of the soil are put in a state of requisition, and may be forced to act till the very soul of vegetation is extracted. It is scarcely practicable to restore fertility to land, even of the best natural quality, which has been thus abused ; at least a considerable period must elapse before it can be restored to its original fertility ; but thin moorish soils, after being exhausted by lime, are not to be restored. To lime them a second time, is not only a useless expenditure of labour and money, but also productive of serious mischief. Soils of this description, after a second liming, are apt to

singe and burn the grain that is sown upon them, and, even when dunged, not to make such a return as would have been rendered under different circumstances.

It is a difficult matter to say at what period the use of lime was first introduced into Britain ; but, as it was well known to the Romans, there is good reason to believe that, by this ingenious people, the use of it was first brought into practice in this island. Be that as it may, this mineral, after undergoing the process of calcination, has long been applied by British husbandmen as a stimulus to the soil, and, in consequence of such an application, luxuriant crops have been produced, even upon soils apparently of inferior quality, and which would have yielded crops of trifling value, had this auxiliary been withheld. In fact, the majority of soils cannot be cultivated with advantage till they are dressed with lime ; and whether considered as an alterative, or as a stimulant, or as a manure, it will be found to be the basis of good husbandry, and of more use than all other manures put together. Whenever lime has been properly applied, it has constantly been found to prove as much superior to

dung, as dung is to the rakings of roads, or the produce of a peat mire.

FROM a pretty long experience, and considerable attention to the operation of lime, we are inclined to think that it acts both as an alterative and as a stimulant, operating in the one case as a medicine, that changes the nature of the soil, and in the other, as rousing, or bringing into action, the vegetable powers contained in the soil, which, without such an application, would have remained dormant and inactive. These opinions, we know, are different from those maintained by several ingenious men; but they are supported by the result of numerous trials, undertaken to ascertain how, and in what manner, lime operated upon the soil, and whether it could be used in a *hot* or *effete* state with the most advantage. On these points, theoretical writers are apt to fall into mistakes; therefore every theory, not formed from facts, ought to be viewed as a romance, which may amuse, but cannot instruct agriculturalists.

FOR more than thirty years we have been in the regular habit of applying considerable quan-

tities of lime ; indeed few of the profession have used more of this useful article. In the majority of cases the application has been highly beneficial, changing in a manner the very nature of the soil, and causing it to produce the most abundant crops ; whereas, in others, it has been altogether useless, and, in some instances, followed by mischief instead of benefit. As most of these trials were executed upon a large scale, and upon soils of almost every different quality, more benefit may perhaps be gathered from a succinct account of them than from a long chain of argument. The trials are fairly stated ; and the results may perhaps throw some light upon this abstruse subject.

It is proper to premise, that a good deal of uncertainty prevails with agriculturalists respecting the application of this article ; and that disputes have often occurred among those who have applied it only to one kind of soil, and have not used it under different circumstances. Some have contended, that lime ought to be applied when it is in a hot powdered state ; alleging, when it becomes *effete*, that the effects are comparatively trifling and unavailing. Others maintain,

that grass land is the best bed for the reception of lime, while many of our most enlightened farmers strenuously affirm, that it is most judiciously used when the land gets a complete summer-fallow. It would not be difficult to prove, that each class of disputants, in the view taken by them of the subject, are equally right; and that they only condemn the system of others because their own has turned out successful. Our opinion is, that in every case where the land is constitutionally disposed to receive benefit from a calcareous dressing, that is, when it is refreshed by grass, or enriched by dung, it is of little importance, in respect of operation, whether lime is applied hot or *effete*, upon grass land or upon fallow; and that convenience ought chiefly to be studied when the proper time for applying the article is to be ascertained. In point of economy, there can be no doubt but that lime is most economically used when laid upon land hot from the kiln: this mode also lessens the expence of labour considerably; consequently, the practice of using it when *effete* is more expensive. It is obvious, however, that a choice of season is not always in the farmer's power, and that imposing necessity often obliges him to lay on lime when

completely *effete*. Repeated trials, however, have convinced us, that its operations are equally beneficial in the one state as in the other; though the expence, in the last case, as already said, is greater than in the former. With regard to the other branch of dispute, whether land in grass, or land in fallow, is the most proper bed for the reception of lime, we are of opinion that the difference is immaterial. If grass land is clean, and if lime can be got forward at the time, the application will be as efficacious upon it as upon the richest and best wrought summer-fallow.

THAT these things are not matter of opinion, we mean to show, by detailing the results of trials made to ascertain the facts. To render these details more perfect, we shall mention the nature of the surface and subsoil upon which the several trials were made, and explain the state of the ground at the time; and, when necessary, the management practised for a series of years afterwards.

FIELD, No. I. was soil chiefly composed of thin clay, some of it approaching to a moorish qua-

lity, *i. e.* mixed with peat earth ; the whole incumbent upon a subsoil retentive of moisture.

THIS field had been in grass for several years, but yielded very poor returns. It was fallowed without taking any corn crop ; and the lime, which was brought forward during the summer months, was applied in the following spring previous to the seed-furrow being given. At that time it was completely *effete*, and would hardly go from the shovels. About 45 Linlithgow barley bolls, or 270 Winchester bushels, as originally laid down, were applied to each Scottish statute acre.

FIRST YEAR—The crop was oats, but little benefit was discovered from the lime.

SECOND YEAR—The ground began to ferment, which showed that the lime was in action. The husbandry of flax being then in vogue, it was tried upon this field ; and the crop was excellent, both in respect of flax and seed.

THIRD YEAR—It was sown with gray peas after two furrows, which returned a great bulk

of straw, but not much grain. The clay part of the field was now quite loose and free, while the moorish soil seemed more compact and firm.

FOURTH YEAR--Red wheat was sown, which turned out a bulky crop, though the season was adverse. The straw was hard, bright, reedy, and of great length. Perhaps the greatest quantity of dung applied at once would not have produced such a crop.

FIFTH YEAR—The field was summer-fallowed, but no dung was applied.

HERE it may, with justice, be urged, that a great error was committed in withholding dung at this stage; and it is acknowledged that a dose of manure, had circumstances permitted, could not have been more beneficially bestowed. In vindication of our management, we can only state that, at the period in question, dung was a scarce article upon the farm, and that many fields would not crop at all if it was withheld. The one under consideration appeared quite capable of carrying several more crops without assistance; consequently, viewing the economy of

the farm as a whole, it was thought preferable to act in the manner described. Many things are eligible in general management which cannot be executed; and, as in public affairs, a partial evil must often be committed to promote the general good.

SIXTH YEAR—The field was sown with oats, and produced a heavy crop, both of straw and corn. Grass seeds were sown with the oats.

SEVENTH YEAR—The field was depastured with cattle. The grass was but indifferent, which is a common circumstance upon new limed land; at least where a heavy dose is given. This induced us to plough it again in the succeeding spring.

EIGHTH YEAR—Oats were sown, which yielded a decent crop.

NINTH YEAR—The field was thoroughly summer-fallowed and dunged, at the rate of sixteen double loads to the Scottish acre. Wheat was sown.

TENTH YEAR—The crop of wheat was excellent, being not only bulky, but of fine quality.

ELEVENTH YEAR—Oats and grass seeds were sown, and the ground surrendered to pasture. Since that time it has been a few years under corn; and, though the produce of these crops cannot, by any exertion, be made equal to those which are enumerated, yet the soil is evidently much improved in every respect, when compared with its original state, previous to the lime being applied.

FIELD, No. 2. was a real moorish soil, incumbent upon a close bottom, which had been over-cropped after lime by a former tenant.

WE began with a summer-fallow, and applied a part of the same kind of lime which answered so well upon Field No. 1. The lime was laid on during a hard black frost, at the rate of 35 bolls, or 210 bushels per acre, and was then *effete*. Oats were sown; but the crop was a poor one, and the after attempts were not more successful. The stalk of the plant generally singed and de-

cayed after the strength of the seed-pickle was gone; which is a sure proof of ground being worn out with lime. This will always happen, though in different degrees, upon all such land, unless a considerable quantity of dung is bestowed; which unfortunately, in this instance, was not the case.

FIELD, No. 3.—The soil was of a moorish quality, but superior to that of No. 2.

WE fallowed the field out of grass, and applied lime hot from the kiln; but the consequences were much the same as mentioned in the preceding instance. The oat-crop looked brisk at first, but decayed daily, as the strength of the pickle was exhausted. Tried dung with a second fallow, when the lime appeared to operate in a trifling degree, but not to that extent as to repay the expence incurred.

FIELD, No. 4.—The soil was partly thin clay, the remainder of a soft sandy nature, but all upon a wet bottom.

THIS field had lain, for a great many years, in grass, and displayed no signs of having been previously limed. We applied the lime upon the grass surface, when it was *effete*, and ploughed for oats: the crop good. The lime did not come into full action till the third year, when pease were sown; and, for a number of years afterwards, the different crops taken were not inferior to those of the best infield.

FIELD, No. 5.—The soil was chiefly a soft loam upon a wet bottom; which, at any rate, had not been limed since the ridges were levelled and streightened.

THIS field was summer-fallowed after a crop of wheat, and dunged substantially, as it appeared to be in an exhausted state. Lime hot from the kiln was then applied, at the rate of 40 bolls, or 240 bushels per acre, which operated immediately. It is now sixteen years since the application; during which time, the field has been only three years in grass, and yet its effects have not ceased.

FIELD, No. 6.—The soil, a strong loam incumbent upon clay, which had carried five crops of grain after being ploughed from old grass.

WE summer-fallowed and dunged this field; applied lime also, which was laid on hot from the kiln, in the month of August, after six ploughings were given. The quantity applied was forty barley bolls per acre; which, in less than a month, occasioned a fermentation of the soil, something similar to what is produced by yeast upon unbaked bread. In one respect, the improvement made upon this field by lime was conspicuous. Barley could, with difficulty, be raised before lime was used; whereas, afterwards, fine crops of this grain were procured with facility. The ground was likewise much easier ploughed and harrowed than formerly, which is always a sure token of an improvement being accomplished.

FIELD, No. 7.—The soil generally a thin sharp loam, a great part of it incumbent upon a close bottom. It had been three years in grass, and was sown down in good order; therefore a proper subject for receiving lime upon the sward.

There was reason to believe that lime had been applied by a former tenant, but this was not certain. After harvest, we laid on from thirty-five to forty bolls per acre not thinking the soil required a heavy dose. It was partly hot, and partly *effete*, as generally happens at that season of the year.

FIRST year, oats were taken; the crop good. Second year, drilled beans, with intervals of twenty-seven inches; the ground being twice ploughed before sowing, and four times horse-hoed; crop middling. Third year, wheat after one ploughing, which yielded a full average crop. Fourth year, it was under summer-fallow; to which 12 double loads of dung per acre were given. Fifth year, in wheat; crop excellent. Sixth year, in drilled beans, which were managed as above. Seventh year, wheat; crop above mediocrity. Eighth year, barley, with grass seeds, after three ploughings; which, though the season was adverse (1799), turned out a decent crop. Ninth year, under grass, which was pastured with cattle, and not inferior to any in the country.

It may be objected, that the above is hard cropping. This may be the case; but we are far from acknowledging that hard cropping, in certain cases, is inconsistent with good farming. The expence of lime in general is so great, that a necessity for hard cropping may be said to be thereby created. Besides, this necessity is increased by the general shortness of leases, which impedes every permanent improvement; and, in the usage of lime, calls for the utmost exertion of the tenant, that he may be reimbursed his extraordinary outlay and trouble.

FIELD, No. 8.—The soil was chiefly loam, though of different varieties, and mostly incumbent upon a close bottom.

THIS field, which consisted of fifty acres, had been cropped for time immemorial; and, when we entered into the farm, was so tired with carrying wheat, that it was scarcely worth the ploughing. It was therefore laid down to grass with all convenient speed. In this state, it remained five years, when it was broken up again; thirty acres having been limed upon the sward, at the

rate of forty barley bolls per acre. Some of the lime was laid on three years before ploughing, some of it two years, and the remainder a few days before the ploughs entered. Part of it was hot, part of it *effete*; but the effects over the whole field, even in the first year, were nearly the same; if there was any difference, the ridges last limed fermented most, but the crop was equally bulky wherever the lime had been applied; though, upon the twenty acres unlimed, the inferiority was evident. From this it appears, that it was not necessary to apply lime to grass land one or two years before it was broken up, as inculcated by several writers upon husbandry; a practice, at any rate, not reconcileable with economy, as much of the lime is washed off the surface, and carried away by rain before the ground is ploughed.

FIELD, No. 9 — The soil was chiefly thin clay, incumbent upon a bottom of till; consequently, subject to receive injury from wetness. This field had been severely scourged by the preceding tenant; had been injudiciously streightened, which is a fatal measure to such soils; had been limed previous to the streightening;

but, at our entry, was wholly under crop, and in an exhausted state.

AFTER being summer-fallowed, in as perfect a way as circumstances permitted, this field was laid down in grass, and depastured with cattle for several years. Lime (the greatest part of which was in an *effete state*) was applied upon the sward during the winter months; and, in February following, the field was ploughed for oats. The crop was middling good; but, in the six subsequent years, it did not appear that much benefit was gained from the application. In the eighth year, however, the lime acted vigorously; a small part of the field which remained unlimed being at least 50 *per cent.* inferior in crop, though the management, in every other respect, was all along similar.

It is difficult to account for this cessation of action during so long a period, though it is believed that instances of the like nature are not unfrequent upon secondary soils. Whether a deeper ploughing had been given in the preceding season, which might bring the lime to the

surface; or whether the original poverty of the soil precluded the lime from operating, till it was assisted by a copious application of dung, are circumstances not easily ascertained. In our opinion, the lime was brought into action by the dung bestowed; though it would be rash to state, as a matter of fact, what, at best, is only a probable conjecture.

FIELD, No. 10.—The soil was of various qualities. Part of it a thin loam; part of a sandy nature; and the remainder approaching to a thin clay; but all upon a bottom retentive of moisture. After pasturing the field for one year, we applied lime upon the sward, at the rate of 40 Linlithgow barley bolls, or 240 bushels per Scots acre. The lime was partly hot; but the greatest part of it was *effete*, which must necessarily be the case when lime is *huted*, unless the huts are completely covered. No difference, however, was discovered in the operation, from the state in which the article was applied.

FIRST year—The crop was oats. The season being excessively dry, little benefit was got from the lime.

SECOND year—Fallowed the field completely, and dressed it with dung, at the rate of fourteen double loads per Scots acre.

THIRD year—Sowed barley and grass seeds. The crop of barley was very good.

FOURTH year—The field was depastured with cattle.

FIFTH year—It was ploughed for oats. Crop excellent.

SIXTH year—Drilled pease and beans, after two ploughings, which were managed as already described; the crop was of great bulk, and produced fully nine bolls per acre.

SEVENTH year—Wheat was sown, and the crop was excellent.

FIELD, No. 11.—Was of an inferior kind of loam, upon a close bottom. The year when this field was last under summer-fallow, we applied lime to a part of it, by way of trial. Dung was

given likewise. We sowed barley and grass seeds ; and afterwards took a crop of hay, when the land was ploughed for oats. Every one of these crops was strikingly superior, where lime had been given ; indeed, the superiority was recognisable at a considerable distance.

FIELD, No. 12.—The soil was chiefly a heavy deep loam ; some of it a strong, tenacious, red clay, but almost wholly incumbent upon a close bottom.

WE ploughed this field from old grass, and sowed it with oats. It was summer-fallowed in the second year, and dressed with lime, which was mostly applied hot from the kiln ; being drawn from the cart in regular sized heaps of five pecks each, or thereby, and spread the moment it was slacked by rain, or atmospherical moisture. About two-thirds of the field received 50 barley bolls, or 300 bushels per acre ; the remainder from 60 to 70 bolls per acre ; and the operation appeared to be in direct proportion to the quantity applied ; nor was there any distinction discernible betwixt what was applied hot and what was completely *effete* ; some of it, indeed, the season being remarkably wet, was

nearly in a mortar state: the whole answered well, and operated immediately.

IT was noticed, in this field, that a few ridges, on which the lime was spread in a windy day, carried crops rather inferior to those of the contiguous ones: we apprehend that the most valuable particles of the lime had been carried off; and would recommend that spreading should be discontinued when a high wind arises.

MUCH difference of opinion having prevailed relative to the quality of the several limestone quarries in the neighbourhood, a trial was made of lime from each of them, upon six adjoining ridges of the above field. Though a difference to the eye was visible in almost every one of those samples, yet the effect upon the ground was, from all of them, precisely similar; nor could the most accurate judge say which was best. The quantity applied in each case was the same; and the operations of laying on the lime, spreading it, and ploughing the ground, were all carried on in an uniform manner.

FIELD, No. 13.—Consisted of loam of different varieties, upon a bottom inclined to wetness, and the ridges lying in a broad and serpentine state.

WE ploughed for oats, and then took drilled beans, which were succeeded by wheat. The first and last crops suffered much from the grub. This fallow'd field in the fourth year, cleaving in different breadths, and cross-ploughing the ridges alternately, till the surface was completely levelled; then formed the ground into eighteen feet ridges, applied twelve double cart loads of dung, about one ton each, and fifty barley bolls of lime, to the Scots acre. The lime was laid on hot from the kiln, and spread as fast as it was pulverized. This quantity was found rather too much for the softest part of the field, which, after all, is a circumstance that rarely happens; but on the remainder the fermentation was not greater than necessary; and from this part of the field, the best crops have been procured, though the ridges were both higher and broader, and required more levellings than the other.

WE may now draw a few plain and practical inferences from what is stated.

1st, That lime operates equally well, whether applied in a *hot* or *effete* state, provided the condition of the ground upon which it is used is such as to render a calcareous application beneficial,

2dly, That, in respect of operation, it is immaterial whether lime be used upon grass land or summer-fallow, and that objects of convenience ought chiefly to weigh with the farmer in ascertaining the most proper time for applying this article. Upon old grass land, it is perhaps best to plough first, and to summer-fallow in the second year, when lime can be applied. On new and clean grass land, hesitation is superfluous; it may be limed at the outset, that is, before the plough is admitted.

3dly, That to lime moorish soils is a hazardous business, unless dung is likewise bestowed; but to repeat the application upon such soils, especially if they have been severely cropped, is almost a certain loss, and that a compost of lime

and rich earth is, in such cases, the only substitute.

4thly, THAT strong loams and clays require a full dose to bring them into action ; such soils being capable of absorbing a great quantity of calcareous matter. Lighter soils, however, require less lime to stimulate them, and may be injured by administering a quantity that would prove moderately beneficial to those of a heavy nature.

5thly, THAT upon fresh land, or land in a proper state for a calcareous application, lime is much superior to dung. Its effects continue for a longer period ; while the crops produced are of a superior kind, and less susceptible of injury from the excesses of drought and moisture. Finally, the ground, particularly if of a strong nature, is much easier wrought ; and, in many instances, the saving of labour would almost tempt a judicious farmer to lime his land, were no greater benefit derived from the application than the opportunity thereby gained of working it in a perfect manner.

It may be added, that though strong soils require to be animated with a good dose of lime, those of a light texture will do equally well with little more than half the quantity requisite on the others, especially if they are fresh, or have not already received an application of calcareous matter. In every case it is the farmer only who can judge of the quantity to be given; but, as a general principle, it is safer to exceed the proper quantity than to be below it. In the latter case the application may prove useless, and the whole expence be lost; whereas it rarely happens that injury is sustained from an excess, especially if more or less dung is soon after administered.

SECT. IV.

On Marl.

MARL, like lime, may be viewed as a stimulant, forcing the soil to produce crops of corn

and grass, which otherwise would not have been obtained. Marl has been long known to the husbandmen of Great Britain; and, if we give credit to Pliny, this article was used prior to the Roman invasion. Several kinds are enumerated by the ancient Latin writers, and all of them declare that the soil was greatly enriched by the application of marl.

In many parts of this island the value of land has been much augmented by the application of marl. Treating of this article in a practical way, it may be divided into shell-marl and earth-marl. Shell-marl is composed of animal-shells dissolved; earth-marl is a fossil. The colour of the latter is various; white, black, blue, red, and its hardness is as various as its colour; being sometimes soft and ductile like clay, sometimes hard and solid, like stone, and sometimes extended into thin beds, like slate. Shell-marl is easily distinguished by the shells which always appear in it; but the similarity betwixt earth-marl and many other fossil substances renders it difficult to distinguish them.

SHELL-MARL is very different in its nature from clayey and stone-marls, and, from its effects upon the soil, is commonly classed among the animal manures. The Rev. Mr Dickson states, " That it does not dissolve with water as the other marls do. It sucks it up, and swells like a sponge. It is a much stronger attractor of acids than they." Dr Home says, that it takes six times more of acids to saturate it than any of the other marls which he had met with. But the greatest difference betwixt the shell-marl and the other marls consists in this, the shell-marl contains oils. It is uncertain if the other marls contain any oils ; but this kind, it is said, contains them in great plenty.

THIS marl, it would seem, from the qualities which it possesses, promotes vegetation in all the different ways. It increases the food of plants ; it communicates to the soil a power of attracting this food from the air ; it enlarges the pasture of plants ; and it prepares the vegetable food for entering their roots.

THE shelly sand, often found deposited in beds in the crevices and level parts of the sea-coasts,

is another substance capable of being employed both as a manure and stimulant ; not only on account of its containing calcareous matter in greater or less proportions, but also from the mixture of animal and vegetable substances that are found in it. The portion of calcareous matter which it contains must vary according to circumstances ; but, when the quantity is any way large, and in a reduced or attenuated state, the quality is so much the more valuable. On that account, the quantity which ought to be applied to the soil must be regulated entirely by the extent of calcareous matter supposed, or found, upon trial, to be contained in the article, which, as already said, is very variable.

THE clayey and stone marls are distinguished by their colours ; viz. white, black, blue, and red. The white, being of a soft crumbly nature, is considered to be the best for pasture land ; and the blue, which is more compact and firm, for corn land. In the districts where marl is much used, these distinctions of management are attended to, though either of the kinds may be employed with advantage if the following rules are adhered to.

IF marl is of the blue kind, or of any kind that is compact and firm, lay it upon the land early in the season, so as the weather may mellow it down before the last plough ; and, if on pasture land, let it also be early laid on, and spread very thin, breaking any lumps afterwards which are not completely separated by the first spreading. If marl is of the white, or any of the loose or crumbling sorts, it need not be laid on so early, because these varieties break and dissolve almost as soon as exposed to the weather.

THERE are many kinds of impure and mixed marls, such as sandy, clayey, loamy, and stony marls, according as these varieties of soil are incorporated or mixed with the principal substance. These sorts, of course, are inferior to the pure marls ; but the stony kind is considered to be the best, because its efficacy is more lasting, though the fat and crumbling kinds enrich or operate more speedily. The hard marls, however, in every case, operate for the greatest length of time, and are often followed with bad consequences to the soil, unless good management, with regard to cropping, is exercised during the period of their operation. After being long ex-

cessively fruitful and productive, the soil will gradually become so sterile and barren as scarcely to be worth cultivating; in which case, the greatest exertion can hardly procure a return of fertility. In this respect, the effect of over-cropping land that has been marled, is precisely the same as takes place with lime. An uncommon exertion is made, occasioning a proportionable debility; though, were good husbandry studiously practised, the exertion would neither be so excessive, in the first instance, nor the after-consequences so mischievous. In numerous instances, land has been reduced so much as to be thought little better than useless, by the effects of lime and marl. Both, however, are excellent agents in forwarding agriculture though often their agency has been misapplied, and used for mischievous purposes. Under a correct rotation of cropping, and with a suitable supply of dung, neither lime nor marl is injurious. Reverse these circumstances, and the contrary effect must necessarily be produced.

SECT. V.*On Sea-Weed, or Alga Marina.*

SEA-WEED, a plant that grows upon rocks within the sea, is driven a-shore after storms, and is found to be an excellent article for manuring light and dry soils, though of little advantage to those of a clayey description. This article may be applied on the proper soil with advantage to any crop, and its effects are immediate, though rarely of long continuance. As the coast-side lands of the islands are, in every case, of superior fertility to those that are inland, we may attribute this superior fertility to the great quantity of manure found upon their shores after every storm or high tide, whereby the resources of the ocean are brought forward for the enrichment of the lands locally situated for participating in such be-

nefits. The utmost attention has long been paid to the gathering and laying on of this valuable manure ; and, from the extensive line of British shores, both of the main sea and of the numerous estuaries which indent, and as it were divide the main-land, an immense quantity of sea-weed must annually be collected from them.

SEA-WEED is applied at all seasons to the surface, and sometimes, though not so profitably, it is mixed with unrotten dung, that the process of putrefaction may be hastened. Generally speaking, it is at once applied to the soil, which saves labour, and prevents that degree of waste which otherwise would necessarily happen. Sea-weed, in one respect, is preferable to the richest dung, because it does not produce such a quantity of weeds. This may be inferred from the general state of coast-side lands where sea-weed is used. These lands are almost constantly kept in tillage, and yet are cleaner and freer from weeds than those in inland situations, where corn crops are not so often taken.

CLAY-SOILS are not so much benefited by sea-weed as those of a lighter nature ; but whether

this is owing to the properties of clay being unfriendly to the admission of the salts contained in sea-weed, or to soils of that description being generally in a state, when this substance is thrown ashore, which physically unfits them for participating of benefit from the application, is not completely ascertained. The fact, however, is certain, that clay-soils are little benefited by sea-weed, though perhaps the poaching of carts and horses upon them, in wet stormy weather, may in some measure be assigned as the true cause why the same benefit is not gained. When dung is carted out on clay soils in a wet state, we know that the advantage from it is not so great as when the surface is in condition to bear the pressure of the carriages; though, from that result, no person would be justified in maintaining that these soils were constitutionally disqualified to receive benefit from dung. When a coast-side farm contains mixed soils, the best management is exercised by applying sea-weed to dry, and dung to clay-land. In this way, the full advantage of manure may be obtained; and a farm so circumstanced is of infinitely greater value, with respect to manuring and labouring, than one which contains no such variety.

It has lately been suggested by Sir John Sinclair, Bart. and other eminent agriculturalists, that sea-weed possesses a virtue not formerly assigned to it; namely, that it serves to preserve wheat from being mildewed; which, were the fact sufficiently ascertained, would be an addition to our stock of agricultural knowledge of great importance. Where the sea-weed is applied, there can be no doubt that the soil is thereby greatly strengthened, becoming firmer, and, of course, better adapted for preserving the roots of the plant from injury, and for furnishing a regular supply of food. This length we can safely go, such an opinion being in unison with the general sentiments of agriculturalists. Thinking, however, that mildew proceeds entirely from a diseased atmosphere, we are at a loss to find out how sea-weed, at the root of the plant, can act as a preventative against that disease in any other way than what is already mentioned; that is, by consolidating the surface, and giving greater strength to the plants, in consequence of which they are enabled to resist the unhealthiness of the atmosphere. Comparing the operation of sea-weed with that of dung, it will be found that the effect of the latter is to loosen the soil, and to

make it more friable ; consequently, as always happens, fields which have received the greatest quantity of dung are always most susceptible of mildew.

SECT. VI.

*On Paring and Burning the Surface. and using the
Ashes as a Manure.*

THE practice of burning the surface, and applying the ashes as manure to the soil that remains, has been long prevalent in Britain ; and though it has been condemned, nay reprobated by many chemical writers, and prohibited in numerous instances by proprietors, yet, by professional people, who judged of the utility of the practice from the nature and consequences of its effects, it has, almost in every case, been supported, and considered as the most advantageous way of bringing in and improving all soils, where the surface carries a coarse sward, and is composed

of peat-earth, or other inactive substances. The burning of the surface has been viewed as the best way of bringing such soils into action ; the ashes furnished by the burning serving as a stimulant to their dormant powers, and thereby rendering them fertile and productive in a superior degree than could otherwise be accomplished.

THESE have been the sentiments of husbandmen for many generations, and are not to be overturned by the force of abstract reasoning, however plausibly and forcibly urged. Were a field to be burned, and the ashes produced to be removed to another, the objections of chemists would be well founded ; but so long as these ashes are spread upon the surface, and an effect produced upon the remainder of the soil and subsoil, equal, if not superior, to that which is occasioned by calcareous manure, no evil can be dreaded. The soil, in place of being thinned by the burning, is in fact thickened ; because a portion of the subsoil is impregnated and brought into action, whereby the staple is deepened, and its productive powers increased. It must be remarked, however, that, as the effects of burnt ashes, though instantaneous, are not of long

duration, a dressing of dung, in the third year, becomes highly necessary, after which, land so treated, should be restored to grass. The great object to be attended to, when stimulants are employed, is to use gentle and lenient cropping afterwards; otherwise, what with justice might have been considered as a meritorious improvement, may turn out to deserve a contrary character.

WHAT we have said relates to what is generally called paring and burning; that is, paring the surface to the deepness of one, two, or three inches, gathering it into heaps and burning it. We shall now speak of ashes burnt and used in a different manner; that is, when peat-earth is digged and burnt in quantities, and afterwards applied to a field of a different sort of soil or quality. The effects of ashes, used in this way, are precisely the same with those of lime, though their operation is more violent, and therefore sooner over. The first crop is commonly very luxuriant; but, unless dung is afterwards administered, the soil will rather be exhausted than enriched by the application of the ashes.

IN the agricultural memorandums of Robert Ainslie, land-steward to the celebrated John Earl of Stair on his estate of Culhorn in Wigtonshire, some account of the operation of ashes, and the method of making them from peat-earth is described.

ACCORDING to Mr Ainslie, it appears that Lord Stair, in 1728, sent several barrels of earthy ashes from London, of a kind much used by farmers in the south of England as a top-dressing for their grass and tillage lands. These ashes, agreeable to his Lordship's directions, were sown upon two different pieces of ground; viz. on a piece intended for hay, and on a piece sown with barley, while a proportion of them was reserved till their qualities were analysed and ascertained. Both the grass and barley were greatly improved by the dressing of ashes bestowed; and, upon analysing the part reserved, it was found that, with a great proportion of earthy substances, the ashes contained many particles of lime or shelly matter. Hence, Mr Ainslie concluded, that these ashes were either made by carefully burning moss that was strongly incorporated with shell-marl, or that lime had been mixed with them; by means of

which, and the salts, natural to all ashes, it was supposed that their great fertilising quality was produced.

MR AINSLIE received certain directions for burning moss, along with the ashes, which are of considerable importance. He was directed to begin the fire with dry faggots, furze, or straw, then to put on dried moss finely minced and well beaten with a clapper; and, when that was nearly burnt down, to put on moss less dry, but well minced and clapped, making holes with a prong to carry on the fire, and so adding more moss, till a hill of ashes, something of the size of a waggon load, was accumulated, which, when cold, he was directed to carry to the bins, or store heaps, before the ashes got wet. Agreeable to these directions, a good deal of moss was burnt by Mr Ainslie at a very small expence, the people employed soon becoming very expert in the several operations of cutting and burning the moss, and of managing, in the most advantageous manner, the kilns in which it was prepared.

THE generality of agricultural writers, when treating of manures, give innumerable directions

for the management of the several varieties, as if the farmer had a store-house or repository into which each could be collected. We have spoken of them in such a way as may serve every useful purpose; and, without troubling the reader with instructions which cannot be carried into execution, have restricted our details to matters that are practicable by every farmer. We have directed his attention to the management and application of dung, because this article may be considered as the magic wand which influences every rural operation. Instead of troubling him with speculative opinions on the principles of vegetation, and the pasture of plants, subjects of an abstruse nature, and on which the best informed can only form crude and uncertain notions, we have pointed out the manner in which the greatest quantity of dung may be collected, and described the most suitable and profitable ways of applying it to the land. We have treated of lime, and other stimulants, in the same manner; every kind of theory being avoided, unless sanctioned by experience,—the only schoolmaster deserving attention when rural economy is to be illustrated.

CHAP. VIII.

ON THE MANAGEMENT OF ARABLE LAND,
AND THE HUSBANDRY BEST ADAPTED
TO DIFFERENT SOILS.

IF the landed property possessed by any nation is to be considered as the capital stock of that nation, then it becomes an important question, how and in what manner shall the capital stock be managed to the best advantage, so as the nation may derive the greatest possible benefit? This is a branch of political economy seldom much attended to, though obviously deserving the most minute and serious investigation. In fact, it is only of late years that agriculture has been reckoned worthy of public notice. Individuals might, and many of them did, consider it as a parent art; but the great body of the community were disposed to estimate manufactures and commerce as of greater importance: Hence

the British nation have always been more desirous of gaining new territories, than improving those already possessed : hence millions were expended in defending and improving distant colonies, when a small part of the money thus expended would have rendered every quarter of our own island like a garden. There are numerous and extensive tracts, in every part of the country, which stand in need of improvement ; and notwithstanding the high cultivation of many districts, perhaps in every one of them the national capital might be considerably increased, were suitable means devised, and proper encouragement bestowed. To investigate these matters, however, would lead us into a wide field. On that account we refrain from such inquiries, and proceed to illustrate the management of arable land, and the husbandry best adapted to different soils.

SECT. I.

On Rotation of Crops.

REFERRING to Chap. I. wherein the great and fundamental principles of agriculture are described, we enter upon the consideration of a minor principle, viz. the most suitable Rotation of Crops. Though we are perfectly satisfied that, in the variable state of British soil and climate, no fixed rotation can be prescribed, and even that the real value of every rotation depends, in a great measure, upon the fidelity shewn in executing the several processes of labour which belong to it; yet, abstractly speaking, some rotations must be viewed as of more value than others, because the crops therein included may be most suitable for the particular soil or soils on which they are to be cultivated, or better adapted to the market

demand of the country, which ultimately must regulate the kind of produce most deserving of cultivation. Holding these things in view, alternate husbandry, or the system of having leguminous and culmiferous crops to follow each other, must be reckoned most judicious, and deserving of recommendation. This system, with some modifications, is practicable on every soil. According to its rules, the land would rarely get into a foul and exhausted state ; at least, if foul and exhausted under alternate husbandry, matters would be much worse were any other system followed. The rotation may be long or short, as is consistent with the richness of the soil on which it is executed, and other local circumstances. The crops cultivated may be any of the varieties which compose the two tribes, according to the nature of soil and climate of the district where the rotation is exercised ; and where circumstances render ploughing not so advantageous as pasturing, the land may remain in grass till these circumstances are obviated ; care being always taken, when it is broke up, to follow alternate husbandry during the time it is under tillage.

IN this way, it is perfectly practicable to follow the alternate system in every situation ; nor do we consider the land being in grass for two, three, or four years, as a departure from that system, if called for by a scarcity of manure, poverty of soil, want of markets for corn, or other local circumstances. The basis of every rotation we hold to be either a bare summer fallow, or a fallow on which drilled turnips are cultivated, and its conclusion to be with the crop taken in the year preceding a return of fallow or drilled turnips, when, of course, a new rotation commences.

Rotation, No. 1.

ACCORDING to this rotation, wheat and drilled beans are the crops to be cultivated, though clover and rye-grass may be taken for one year in place of beans, should such a variety be viewed as more eligible. The rotation begins with summer fallow, because it is only on strong deep lands that it can be profitably practised ; and it may go on for any length of time, or so long as the land can be kept clean, though it ought to stop the moment that the land gets into a con-

trary condition. A considerable quantity of manure is required to go on successfully ; perhaps dung should be given to each bean crop ; and if this crop is drilled, and attentively horse-hoed, the rotation may turn out to be one of the most profitable that can be exercised.

Rotation, No. II.

UPON loams and clays, where it may not be advisable to carry the first rotation into execution, a different one can be practised ; according to which labour will be more divided, and the usual grains more generally cultivated ; as, for instance,

1. Fallow, with dung.
2. Wheat.
3. Beans, drilled and horse-hoed.
4. Barley.
5. Clover and Rye-grass.
6. Oats or Wheat.
7. Beans, drilled and horse-hoed.
8. Wheat.

THIS rotation is excellently calculated to insure an abundant return through the whole of it,

provided dung is administered upon the clover stubble. Without this supply, the rotation would be crippled, and inferior crops of course produced in the concluding years.

Rotation, No. III.

THIS rotation is calculated for clays and loams of an inferior description to those already treated of.

1. Fallow, with dung.
2. Wheat.
3. Clover and Rye-grass.
4. Oats.
5. Beans, drilled and horse-hoed.
6. Wheat.

ACCORDING to this rotation, the rules of good husbandry are studiously practised, while the sequence is obviously calculated to keep the land in good order, and in such a condition as to ensure crops of the greatest value. If manure is bestowed, either upon the clover stubble, or before the beans are sown, the rotation is one of

the best that can be devised for the soils mentioned.

Rotation, No. IV:

ON thin clays gentle husbandry is indispensably necessary, otherwise the soil may be exhausted, and the produce unequal to the expence of cultivation. Soils of this description will not improve much while under grass; but, unless an additional stock of manure can be procured, there is a necessity of refreshing them in that way, even though the produce should, in the mean time, be comparatively of small value. The following rotation is not an improper one.

1. Fallow, with dung.
2. Wheat.
3. Grass, pastured; but not too early eaten.
4. Grass.
5. Grass.
6. Oats.

THIS rotation may be shortened or lengthened according to circumstances, but should never extend further, in point of ploughing, than when

dung can be given to the fallow break. This is the key-stone of the whole ; and, if it is neglected, the rotation is rendered useless.

Rotation, No. V.

PEAT-EARTH soils are not friendly to wheat, unless aided by a quantity of calcareous matter. Taking them in a general point of view, it is not advisable to cultivate wheat ; but a crop of oats may almost be depended upon, provided the previous management has been judiciously executed. If the subsoil of peat-earth lands be retentive of moisture, the process ought to commence with a bare summer fallow ; but, if such are incumbent on free and open bottoms, a crop of turnips may be substituted for fallow ; according to which method, the surface will get a body which naturally it did not possess. Grass, on such soils, must always occupy a great space of every rotation, because physical circumstances render regular cropping utterly impracticable.

1. Fallow, or Turnips with dung.
2. Oats, of an early variety.

3. Clover, and a considerable quantity of perennial Rye-grass.
4. Pasture for several years, till circumstances permit the land to be broken up, when oats are to be repeated.

Rotation, No. VI.

LIGHT soils are easily managed, though, to procure a full return of the profit which they are capable of yielding, requires generally as much attention as is necessary in the management of those of a stronger description. Upon light soils, a bare summer fallow is seldom called for, as cleanliness may be preserved by growing turnips, and other leguminous articles. Grass also is of eminent advantage upon such soils, often yielding a greater profit than what is afforded by culmiferous crops.

1. Turnips.
2. Spring Wheat, or Barley.
3. Clover, and Rye-grass.
4. Oats, or Wheat.

THIS is a fashionable rotation ; but it may be doubted whether a continuance of it for any considerable period is advisable, because both turnips and clover are found to fall off when repeated so often as once in four years. Perhaps the rotation would be greatly improved were it extended to eight years, whilst the ground, by such an extension, would be kept fresh, and constantly in good condition. As, for instance, were seeds for pasture sown in the second year, the ground kept three years under grass, broke up for oats in the sixth year, drilled with beans and peas in the seventh, and sown with wheat in the eighth, the rotation would be complete ; because it included every branch of husbandry, and admitted a variety in management generally agreeable to the soil, and always favourable to the interest of cultivators. The rotation may also consist of six crops, were the land kept only one year in grass, though few situations admit of so much cropping, unless additional manure is within reach.

Rotation, No. VII.

SANDY soils, when properly manured, are well adapted to turnips, though it rarely happens that

wheat can be cultivated on them with advantage, unless they are dressed with alluvial compost, marl, clay, or some such substances as will give a body or strength to them which they do not naturally possess. Barley, oats, and rye, the latter especially, are, however, sure crops on sands; and, in favourable seasons, will return greater profit than can be obtained from wheat.

1. Turnips, consumed on the ground.
2. Barley.
3. Grass.
4. Rye or Oats.

By keeping the land three years in grass, the rotation would be extended to six years, a measure highly advisable.

FROM what is stated in this Section, every person may at once perceive the facility of arranging husbandry upon correct principles, and of cropping the ground in such a way as to make it produce abundant returns to the occupier, whilst at the same time it is preserved in good condition, and never impoverished or exhausted. All these things are perfectly practicable under the

alternate system, though it is doubtful whether they can be gained under any other. Cross cropping, in some cases, may perhaps be justifiable in practice ; as for instance, we have heard of another rotation, to which that character may in some respects be applied, though, as the test of experience is yet wanting, a decisive opinion cannot be pronounced upon its merits. This rotation begins with a bare fallow, and is carried on with wheat, grass for one or more years, oats, and wheat, where it ends. Its supporters maintain, that beans are an uncertain crop, and cultivated at great expence ; and that in no other way will corn in equal quantity, and of equal value, be cultivated at so little expence, as according to the plan mentioned. That the expence of cultivation is much lessened, we acknowledge, because no more than seven ploughings are given through the whole rotation ; but whether the crops will be of equal value, and whether the ground will be preserved in equally good condition, are points which remain to be ascertained by experience.

It may be added, that winter-sown crops, or crops sown on the winter furrow, are most eli-

gible on all clay soils. Spring ploughing on such soils is a hazardous business, and not to be practised where it can possibly be avoided. Except in the case of drilled beans, there is not the slightest necessity for ploughing clays in the spring months; but as land intended to carry beans ought to be early ploughed, so that the benefit of frost may be obtained; and as the seed furrow is an ebb one, rarely exceeding four inches in deepness, the hazard of spring ploughing for this article is not of much consequence. Ploughing, with a view to clean soils of the description under consideration, has little effect, unless given in the summer months. This renders summer fallow indispensably necessary; and without this radical process, none of the heavy and wet soils can be suitably managed, or preserved in a good condition.

To adopt a judicious rotation of crops for every soil, requires a degree of judgment in the farmer, which can only be gathered from observation and experience. In fact, it cannot be learned in any other school, though, when attained, it may be exercised by every one with little difficulty. The old rotations were calcu-

lated to wear out the soil, and to render it unproductive. To take wheat, barley, and oats in succession, a practice very common thirty years ago, was sufficient to impoverish the best of land, while it put little in the pockets of the farmer; but the modern rotations, such as those which we have described, are founded on principles which ensure a full return from the soil, without lessening its value, or impoverishing its condition. Much depends, however, upon the manner in which the different processes are executed; for the best arranged rotation may be of no avail, if the processes belonging to it are imperfectly and unseasonably executed.

THE above rotations (No. 5. excepted) are meant chiefly for the general run of lowland soils where arable husbandry may generally be exercised. In upland districts where local circumstances cause the plough to be used in a more confined manner, some other rotations may be more eligibly executed. The following one seems not amiss for the dry soils of an upland district where the climate is not too high for the cultivation of wheat.

Rotation, No. VIII,

1. Turnips drilled and dunged.
2. Barley with red clover and rye grass.
3. Grass to be used in soiling or for hay.
4. Wheat. The ground to be ploughed by the end of September if possible, and to receive a slight dressing of dung if it can be procured.
5. Hasting peas, for which crop, two furrows, one before winter and the other at seed time, may be given.
6. Barley with seeds.
7. Pasture.
8. Pasture.
9. Pasture.
10. Oats.

IN this way there is exactly three courses during a lease of thirty years, the period which seems to be most suitable for the present state of husbandry in the upland districts.

As many parts of the upland districts are too wet for turnips, the following rotation may be

successfully practised in situations ineligible for turnip husbandry.

Rotation, No. IX.

1. Plain fallow with dung.
2. Wheat early sown and accompanied with clover and rye grass.
3. Grass to be used in soiling or manufactured into hay.
4. Oats.
5. Tares or any of the varieties of gray peas with a slight dressing of dung, or a more considerable one of compost manure.
6. Barley with seeds.
7. Pasture.
8. Pasture.
9. Pasture.
10. Oats.

ALL these rotations are calculated for land already under the plough, and in some shape decently cultivated. But where the land is in a waste state, it is self evident that none of them

can in the first instance be successfully practised. The following measures are therefore recommended.

Rotation, No. X.

1. BREAK up the waste ground with a strong furrow in winter, or early in the spring months, harrowing it sufficiently in the first year so as the surface grasses and their roots may be rotted and destroyed.

2. GIVE a complete summer fallow ; sparing neither harrow nor roller ; and upon this fallow apply at least 50 barely bolls of good lime shells, taking care to plough them in as hot as possible.

3. Oats.

4. Fallow repeated. Dung to be given if it can possibly be procured.

5. Barley with seeds.

6. Pasture.

7. Pasture.

8. Oats.

At this stage the same system may be followed as already recommended for the old cultivat-

ed lands, holding in view whether the land in question is suited or not for the growth of turnips. In short, the most eligible rotation for every kind of soil may easily be ascertained by a reference to the local circumstances of the district in which it is situated, and the rotation may either be long or short in a direct proportion with the richness of the soil on which it is to be executed. According to the above rotations land would never get into a foul or deteriorated state while the crops cultivated might in every case be adopted to the soil and climate. Circumstances which a sound practical agriculturist will seldom neglect, and which in fact regulate and influence husbandry in every department.

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